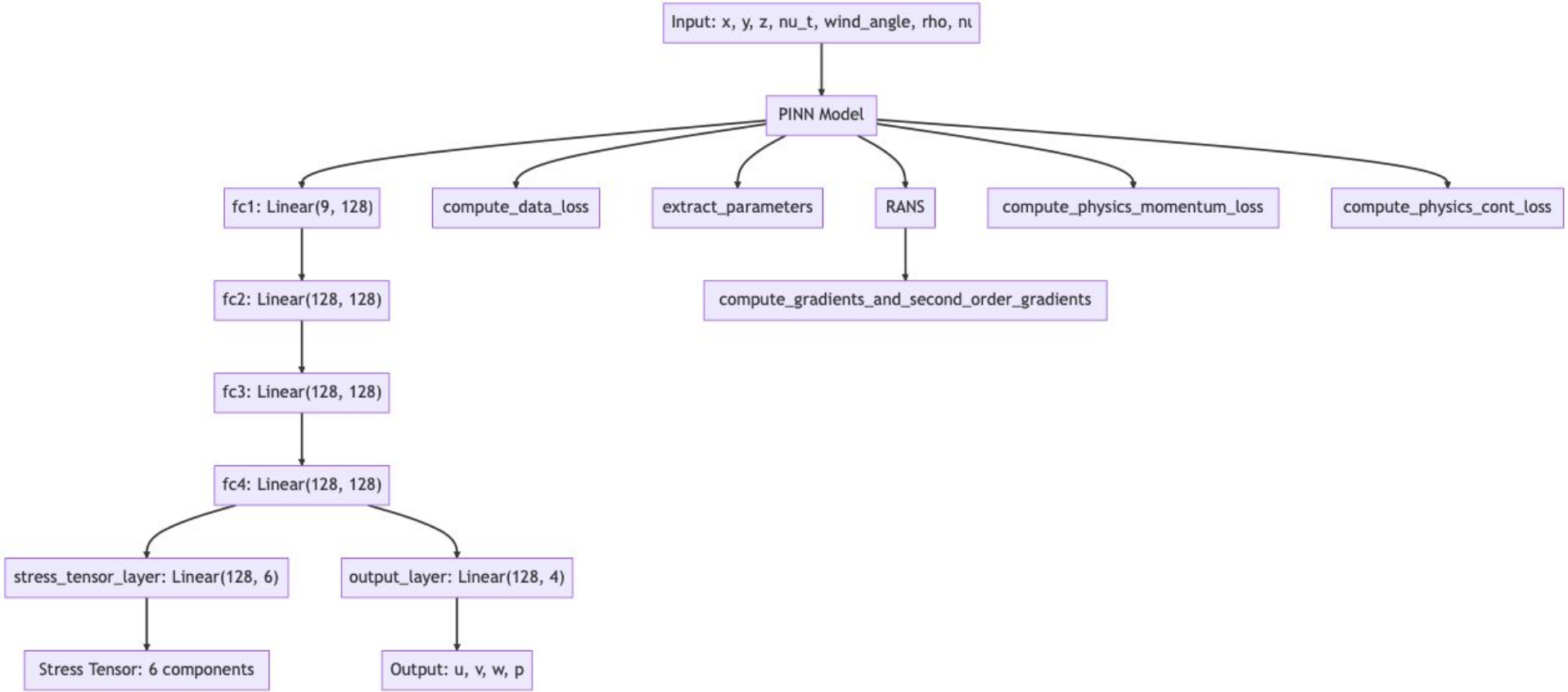
Update on PINNs

Application to Urban Wind Field Dispersion Studies

Claude Guet & Ameir Shaa

Neural Network Architecture



Some Parameters

Infinite epochs - instead the criteria for stopping is loss_{n} - loss_{n-1} < ε for 10 consecutive epochs where n is the epoch number and ε = 1E-5 (user defined)

We have the data for 7 angles, [0, 30, 60, 90, 120, 150, 180] in degrees

We concatenate the data for angles = [0, 30, 60, 120, 150, 180] and then take 80% of the dataset with random seed = 42 for training and 20% for testing

By using the whole dataset we hope to make the NN learn about wind angle such that the parameters become functions of the wind angle

We also would like the stress tensor to be learnt so that we do not have to assume models involving turbulence (ie. model free approach)

Then using the trained neural network we predict the data for angle = 90

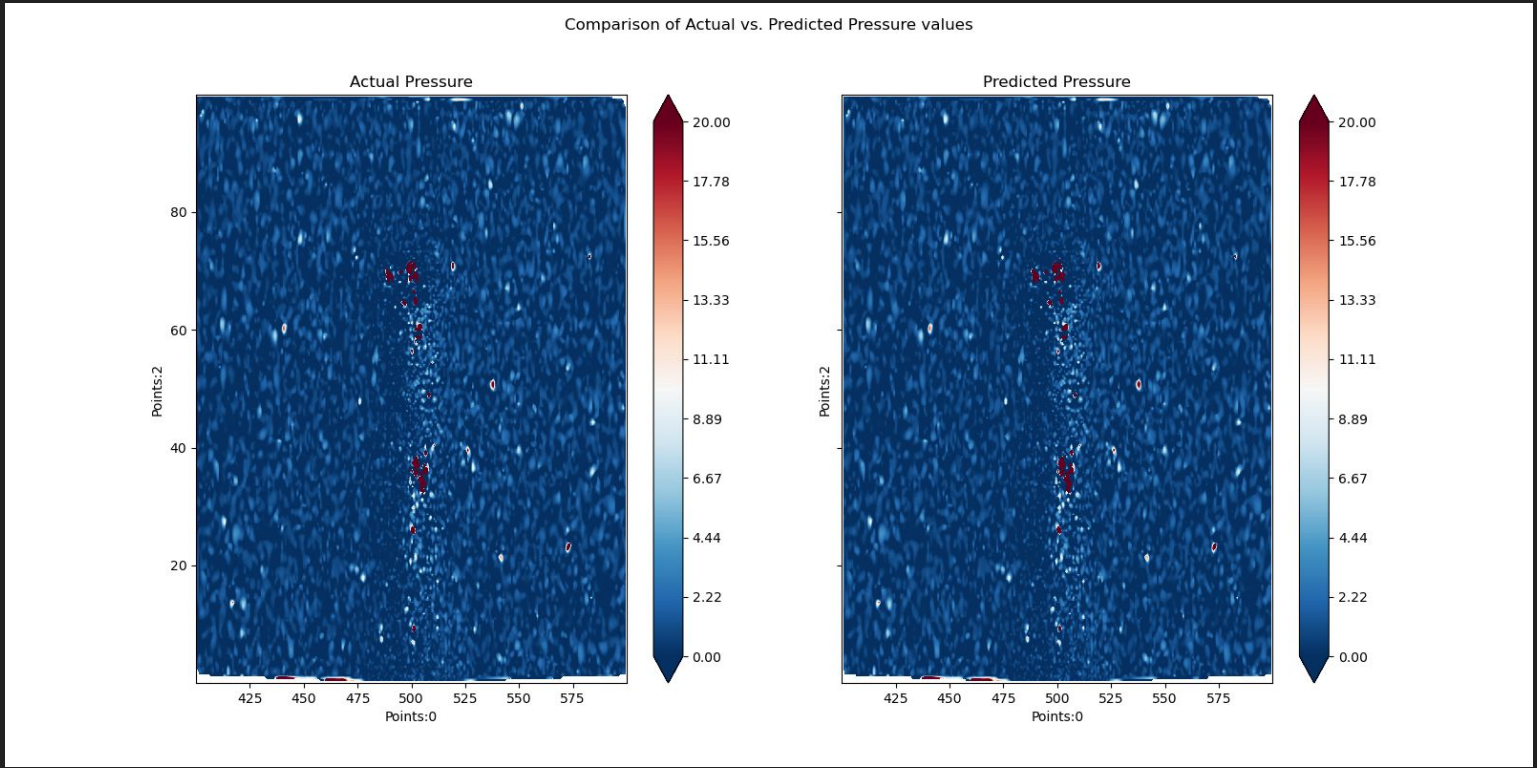
Progress so far - Data Loss Only (Adam Optimizer)

- Testing results are good
- Predicting results are not great

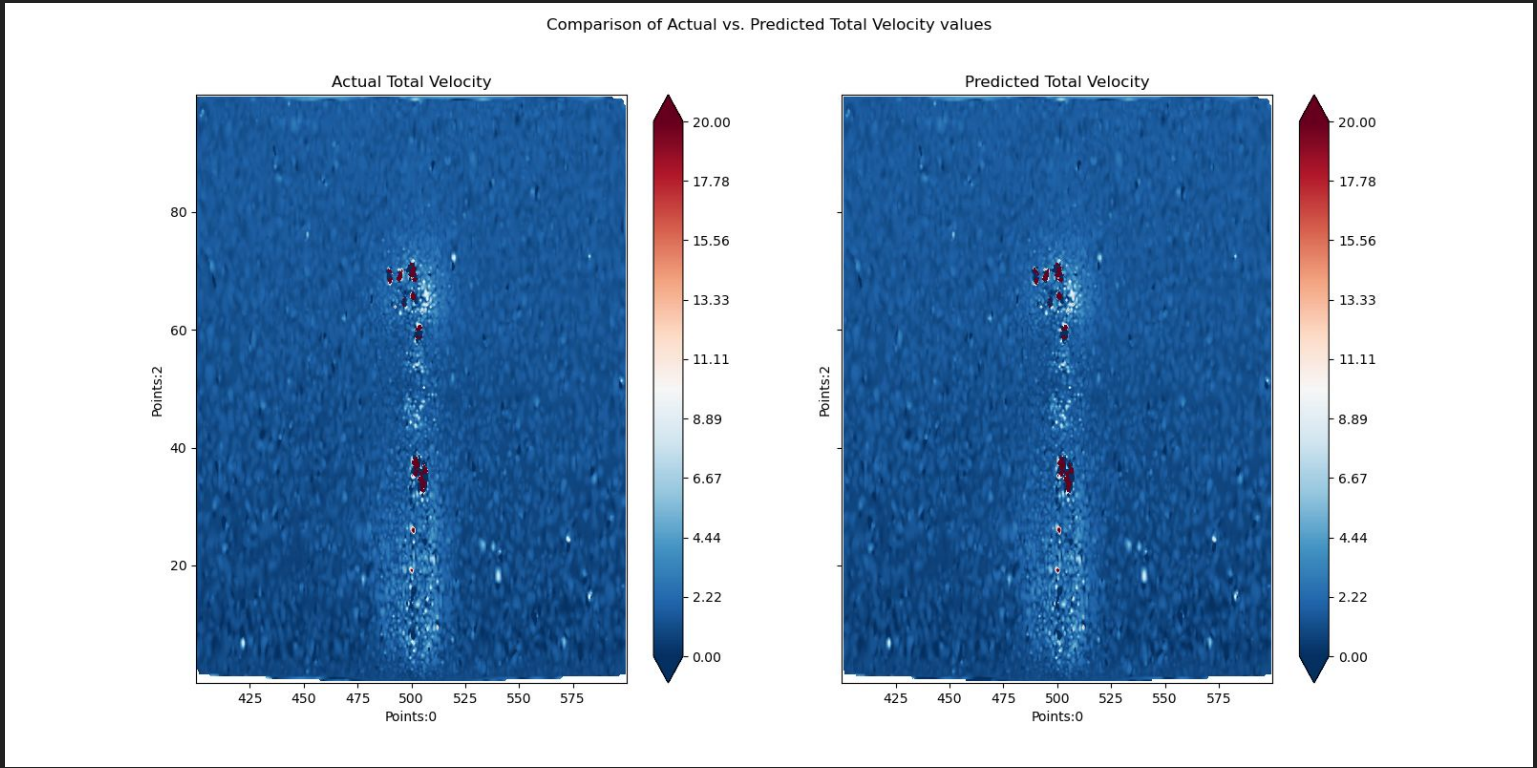
Progress so far - Data Loss Only (Adam Optimizer) - Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.0011776087	0.034316305	0.020423971	0.998823731
Velocity:0	0.0013828328	0.03718646	0.021234445	0.9986191703
Velocity:1	0.0007224323	0.0268781	0.016232971	0.9992781438
Velocity:2	0.0052816323	0.07267484	0.039270695	0.9947135709

Progress so far - Data Loss Only (Adam Optimizer) - Testing Results - X-Z Pressure Plot



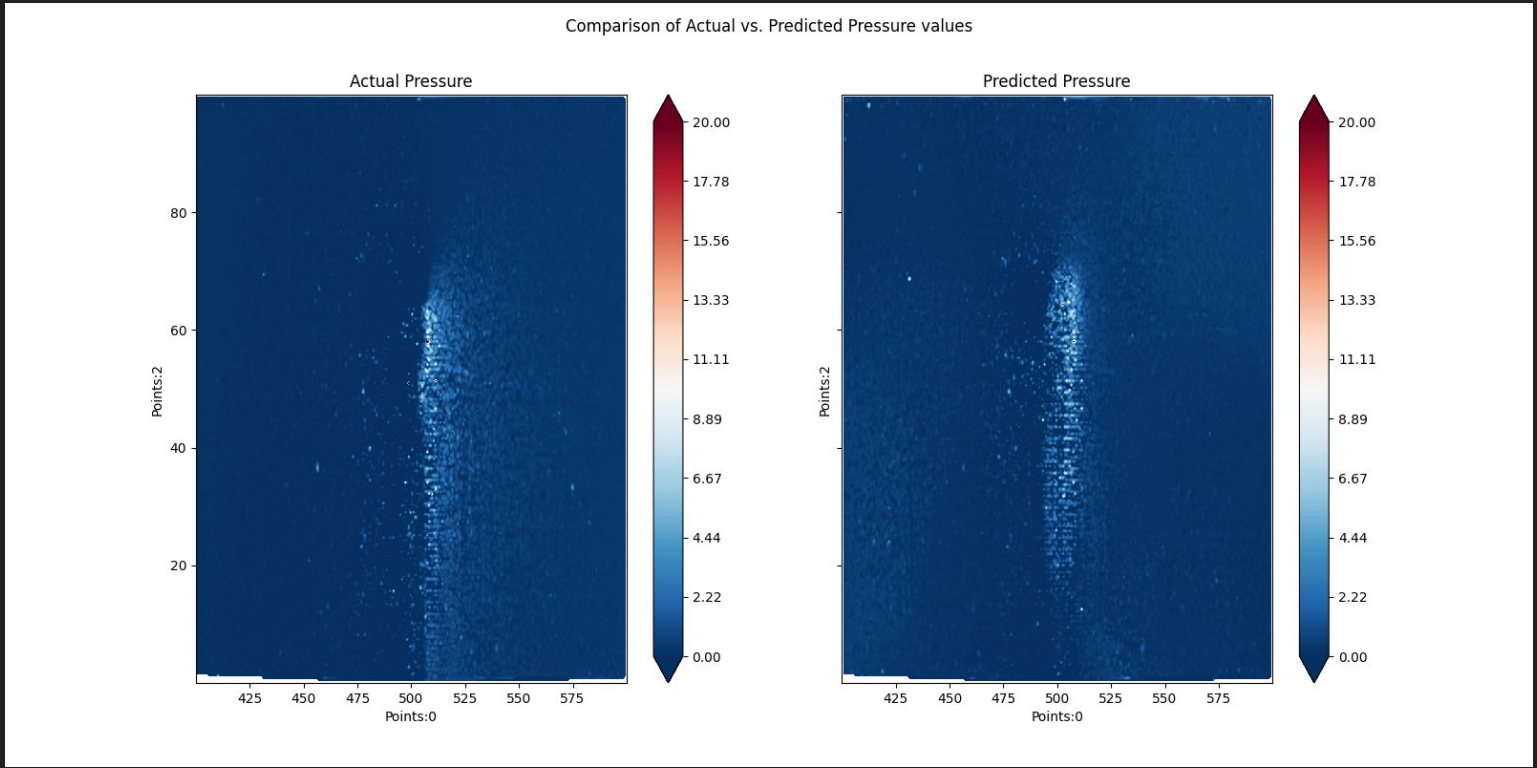
Progress so far - Data Loss Only (Adam Optimizer) - Testing Results - X-Z Total Velocity Plot



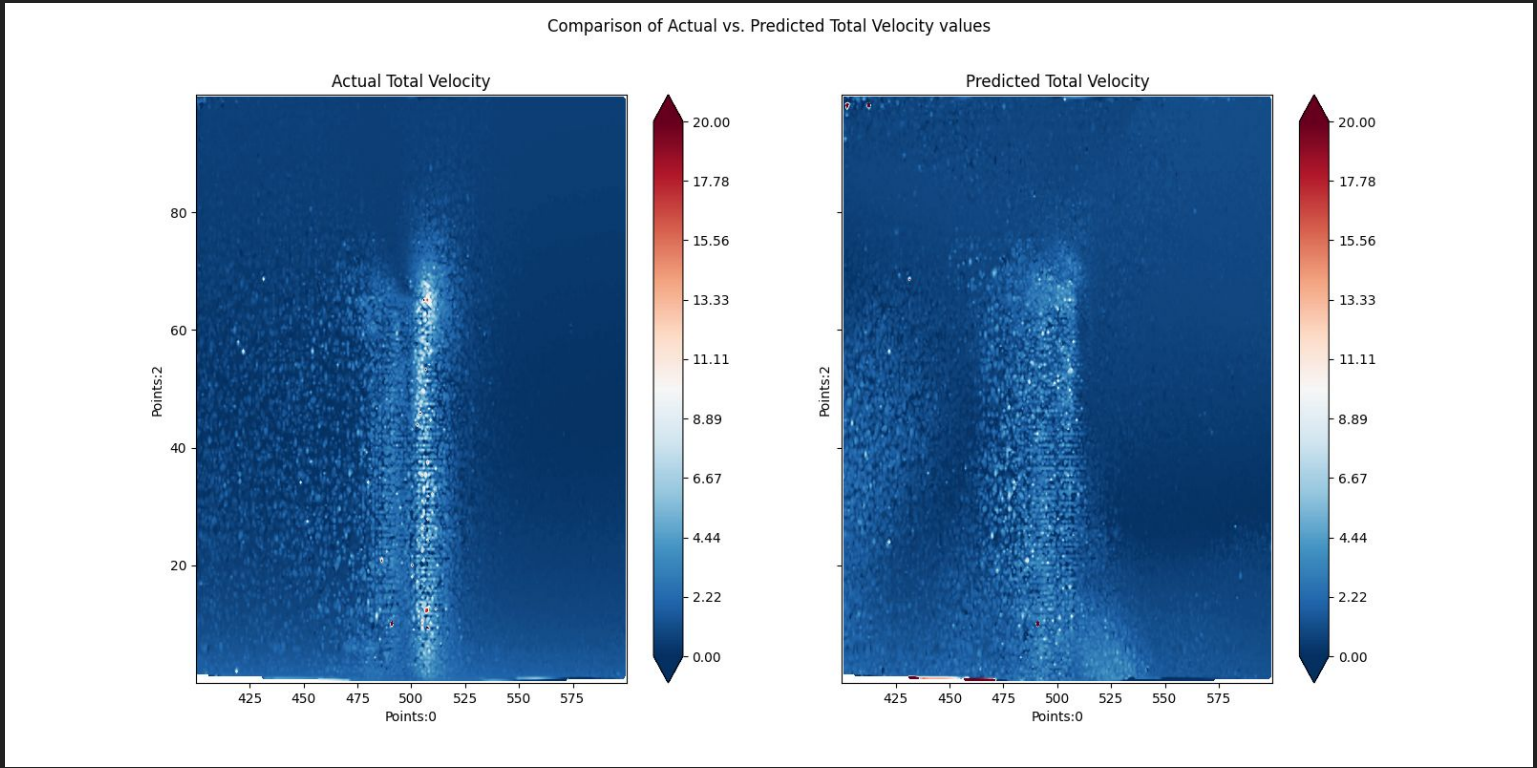
Progress so far - Data Loss Only (Adam Optimizer) - Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	1.5220883	1.2337295	0.53262806	-0.5220843857
Velocity:0	0.36454695	0.6037772	0.4447443	0.6354540529
Velocity:1	1.0641118	1.0315579	0.54127514	-0.06410897082
Velocity:2	2.498988	1.5808188	0.7100876	-1.498980889

Progress so far - Data Loss Only (Adam Optimizer) - Testing Results - X-Z Pressure Plot



Progress so far - Data Loss Only (Adam Optimizer) - Testing Results - X-Z Total Velocity Plot



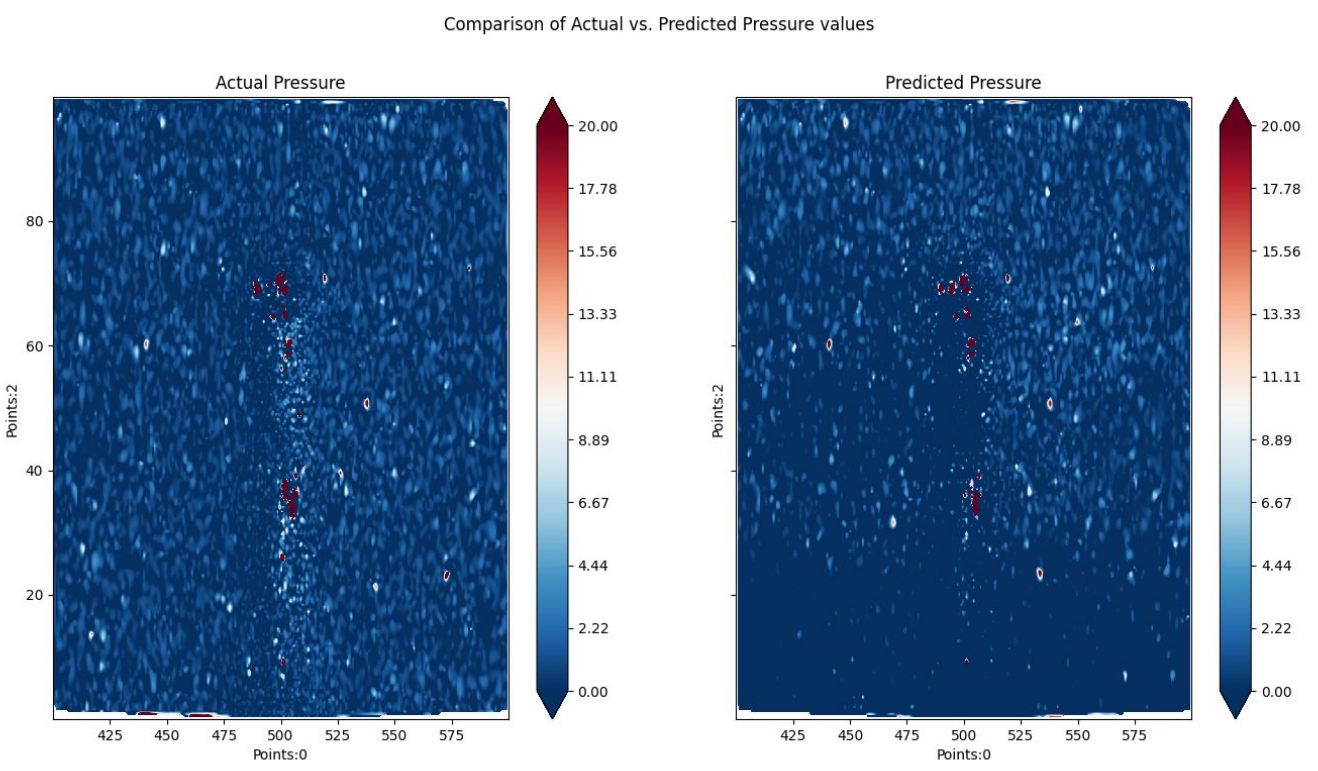
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-3 (424 Epochs), LXPLUS

```
Epoch [400/infinity], Loss: 0.0259, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0178, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0146, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0182, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0198, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0196, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0166, Total Time elapsed: 16.44 hours
Epoch [400/infinity], Loss: 0.0212, Total Time elapsed: 16.44 hours
Consecutive loss difference less than 0.001 for 10 epochs at epoch 424. Stopping training...
Training completed in 17.34 hours
Overall process completed in 62434.54 seconds
```

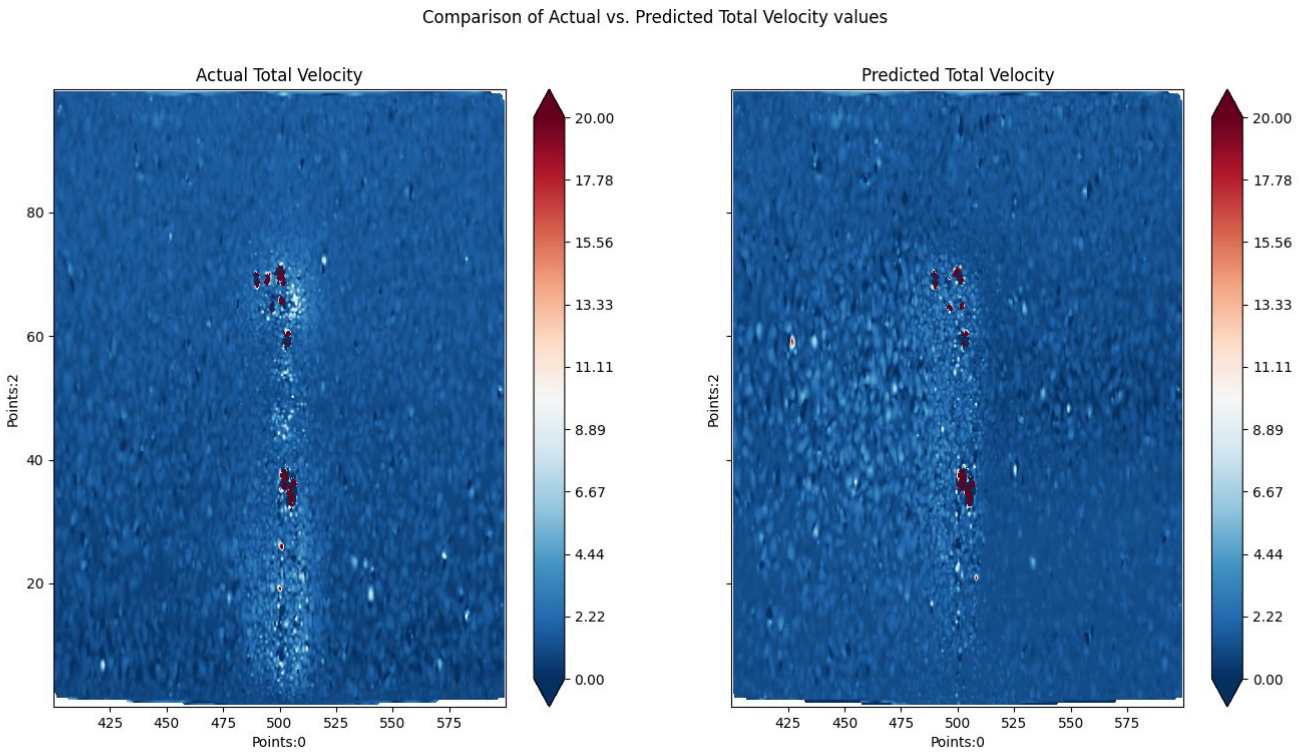
Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	2.3220737	1.5238352	0.9776644	-1.319431998
Velocity:0	0.5095364	0.7138182	0.46124974	0.4912018376
Velocity:1	0.26461294	0.5144054	0.3918977	0.735598087
Velocity:2	1.6482725	1.2838507	0.55500114	-0.6497693851

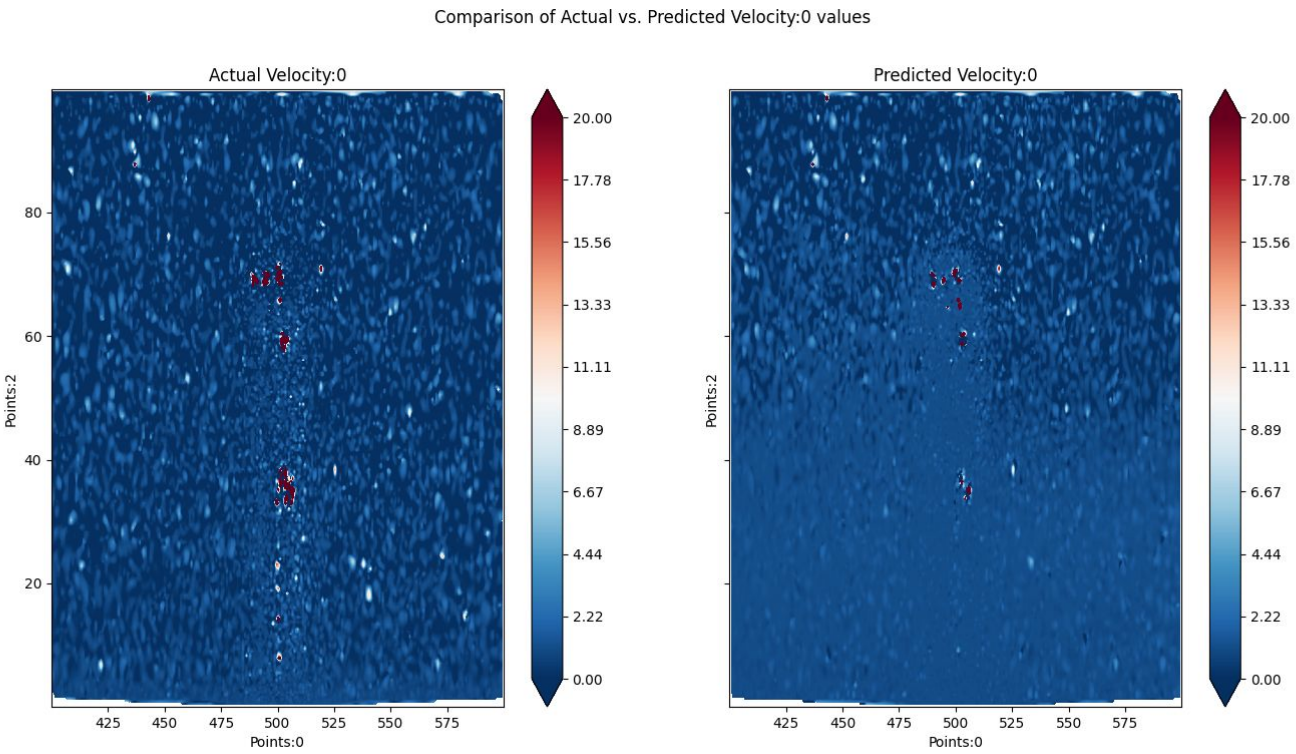
Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Testing Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Testing Results - X-Z Total Velocity Plot



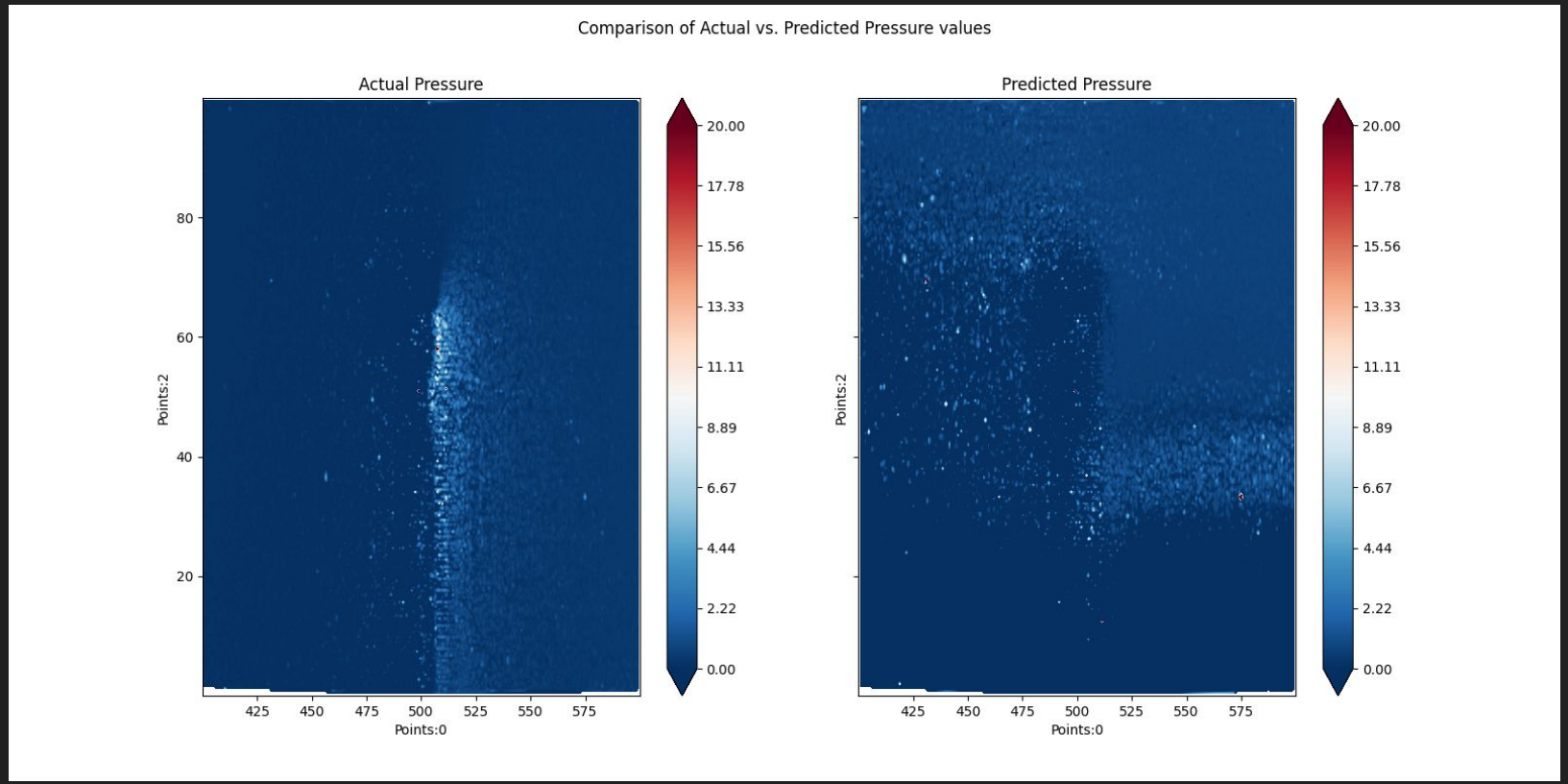
Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Testing Results - X-Z X-Velocity Plot



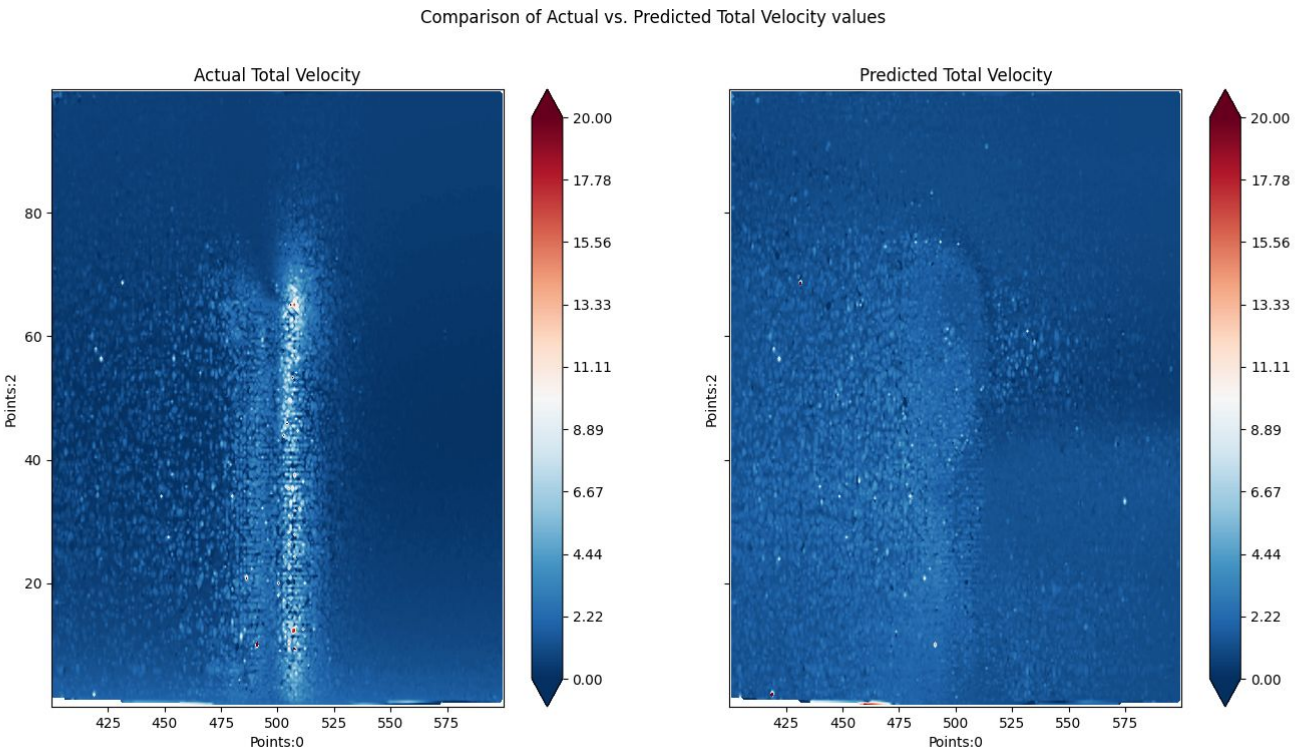
Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	2.6895921	1.6399976	1.0733074	-1.689585109
Velocity:0	0.58838195	0.7670606	0.66586226	0.4116196591
Velocity:1	1.3434067	1.1590542	0.7838025	-0.343403227
Velocity:2	1.4670503	1.2112185	0.58212554	-0.4670461259

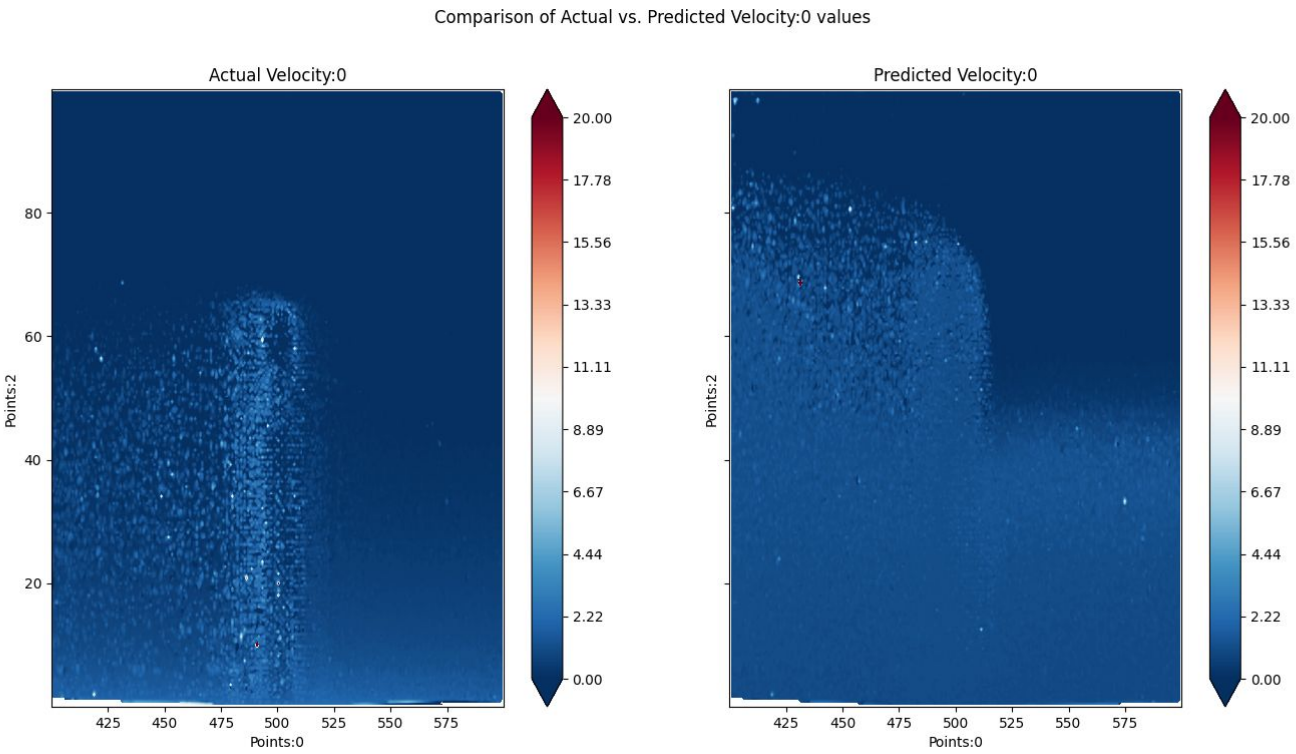
Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Predicting Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Predicting Results - X-Z Total Velocity Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer)
Threshold = 1E-3 (424 Epochs), LXPLUS
Predicting Results - X-Z X-Velocity Plot



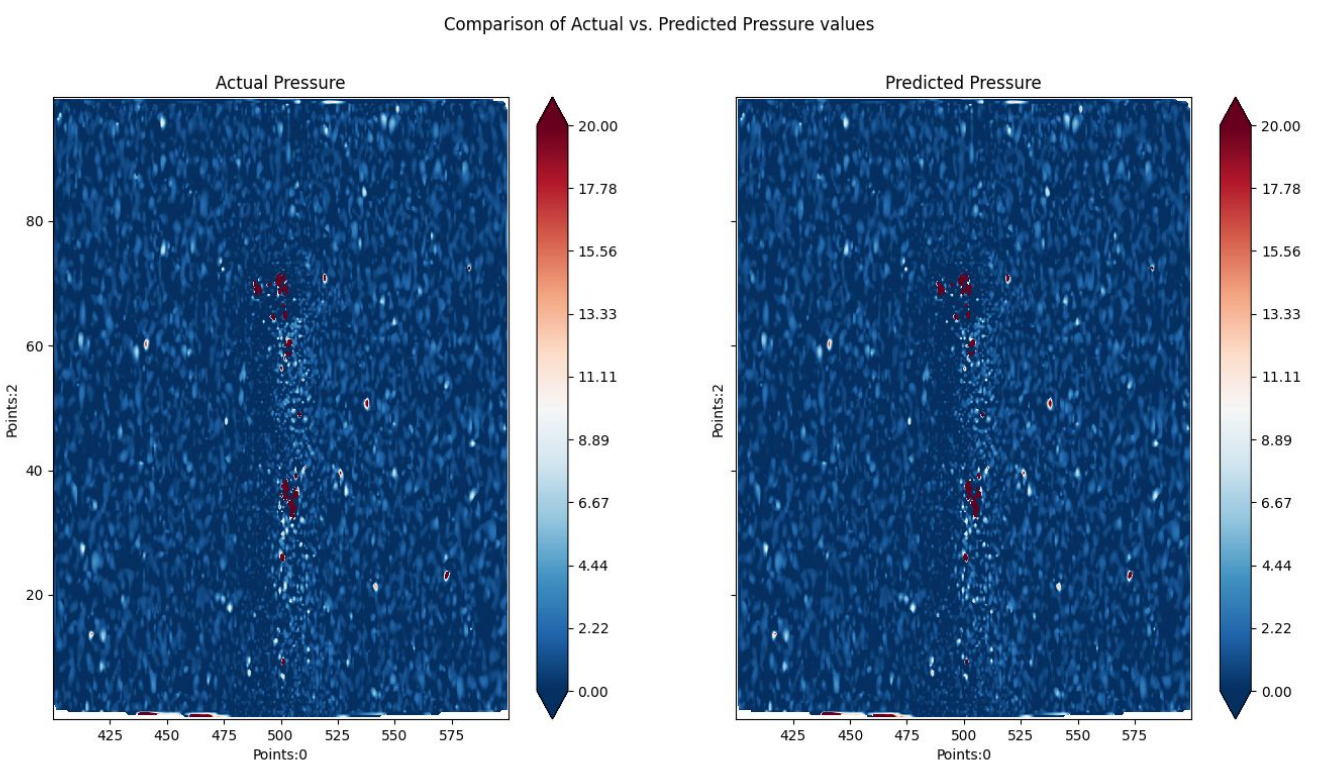
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop

```
Epoch [2000/infinity], Loss: 0.0152, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0153, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0165, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0147, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0161, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0157, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0147, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0144, Total Time elapsed: 19.56 hours
Epoch [2000/infinity], Loss: 0.0151, Total Time elapsed: 19.56 hours
```

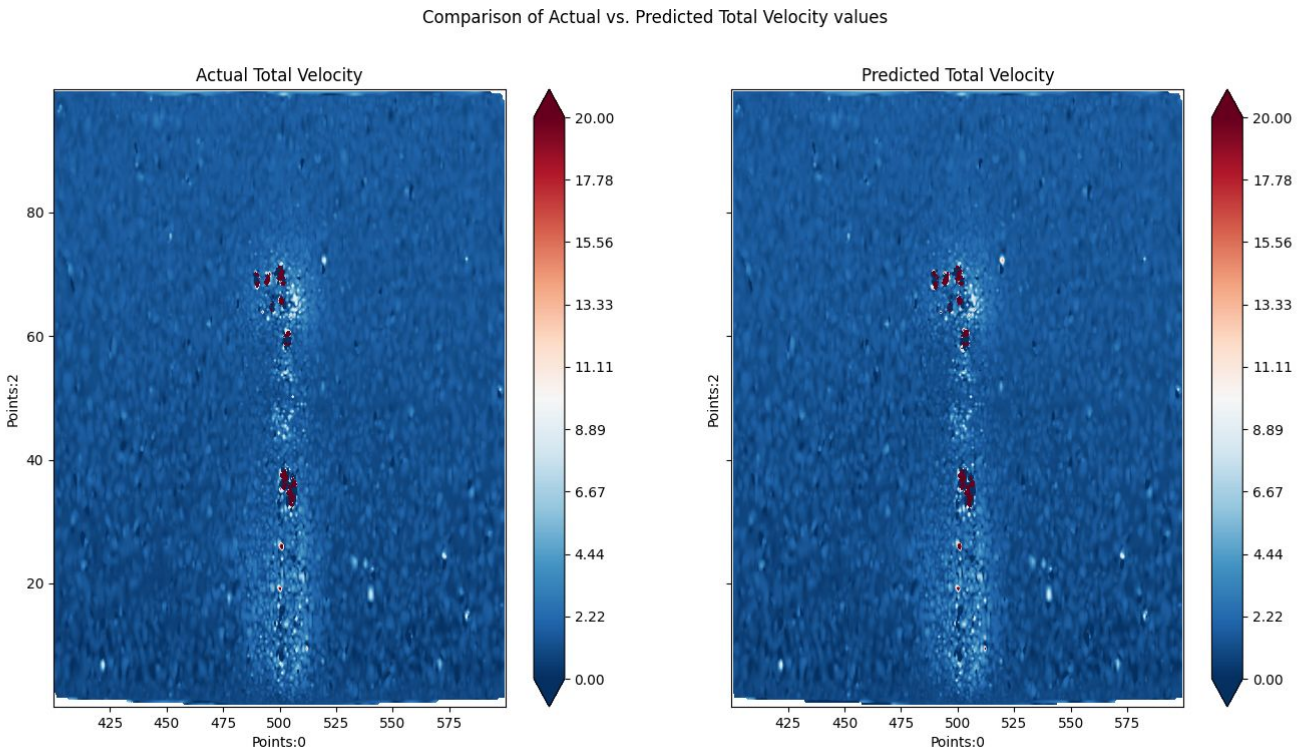
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.027358314	0.16540349	0.067743555	0.9726728091
Velocity:0	0.019014407	0.13789274	0.063468635	0.9810131414
Velocity:1	0.008306418	0.09113955	0.049483087	0.9917002054
Velocity:2	0.024254046	0.1557371	0.07828056	0.9757239281

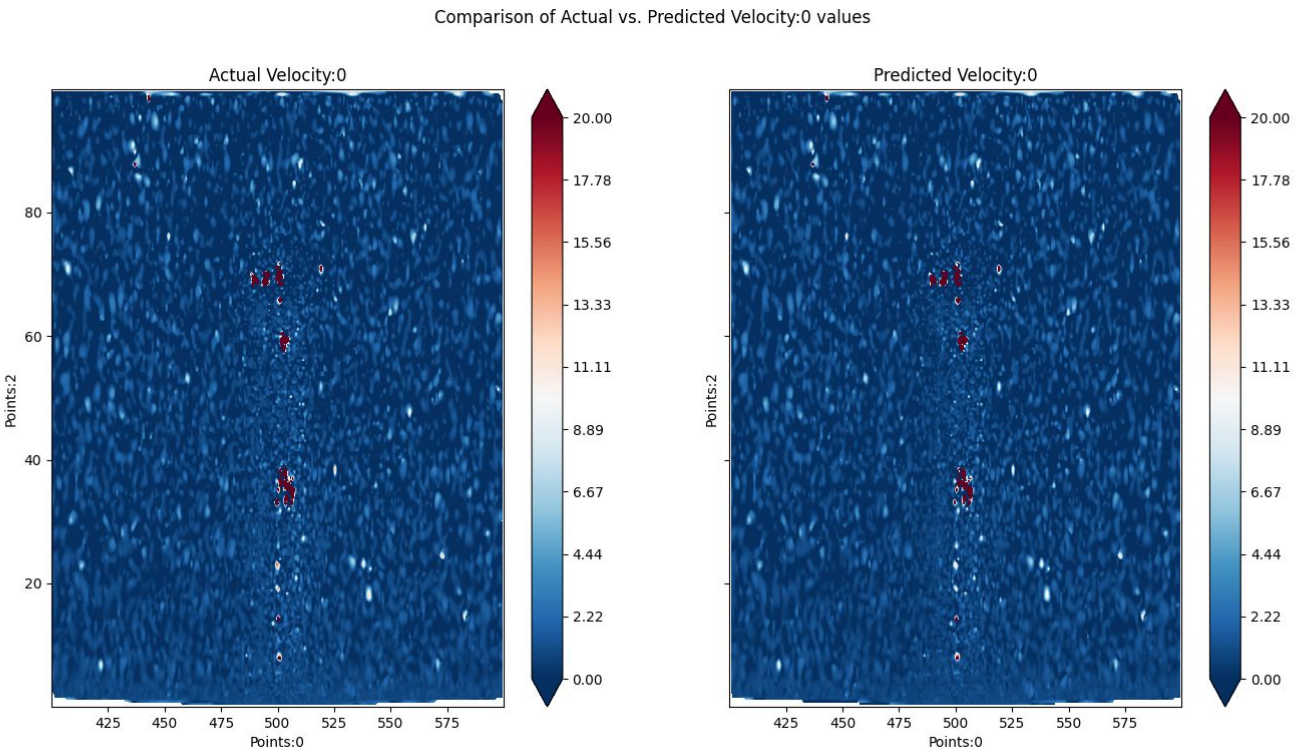
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Testing Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Testing Results - X-Z Total Velocity Plot



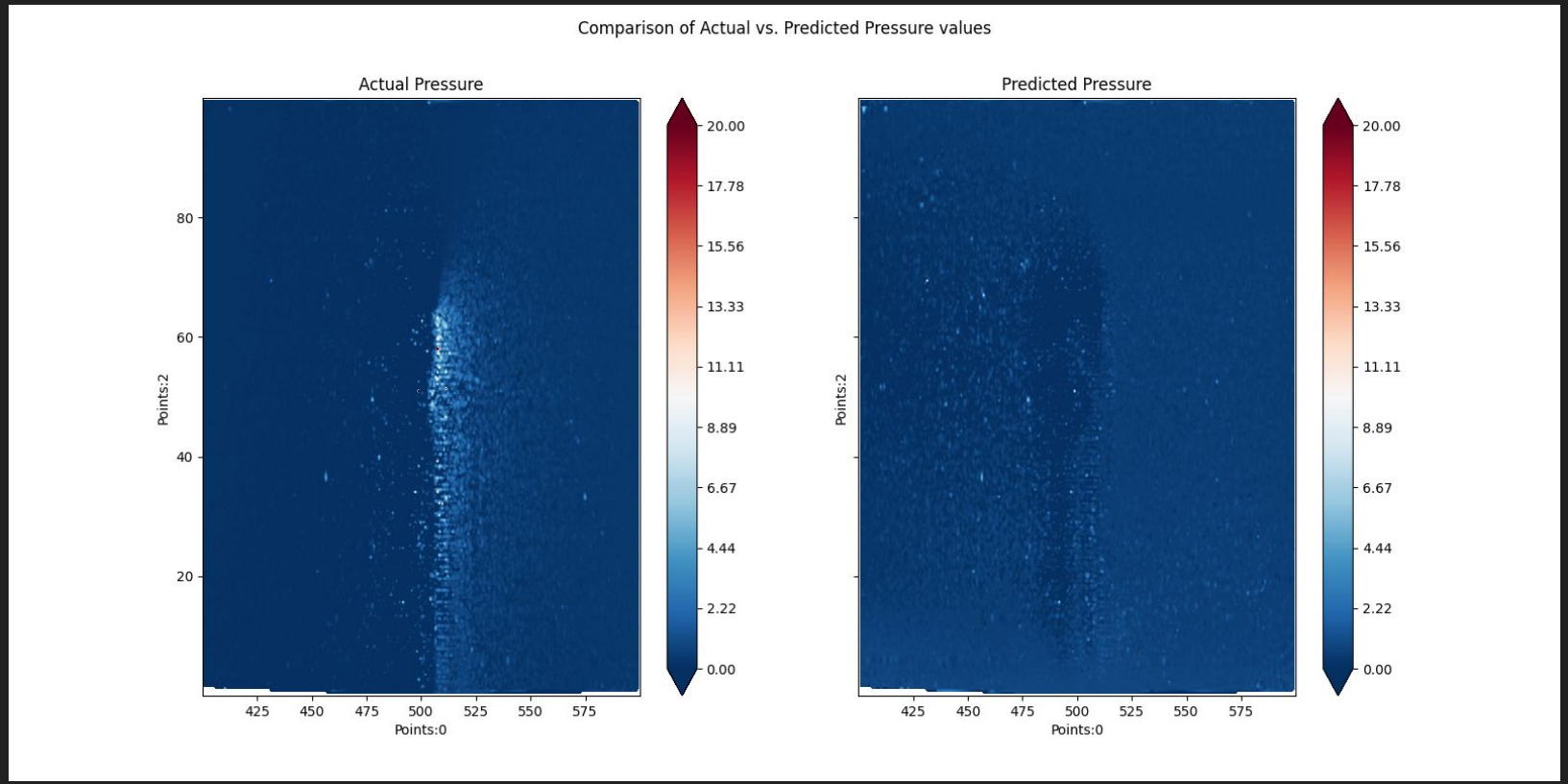
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Testing Results - X-Z X-Velocity Plot



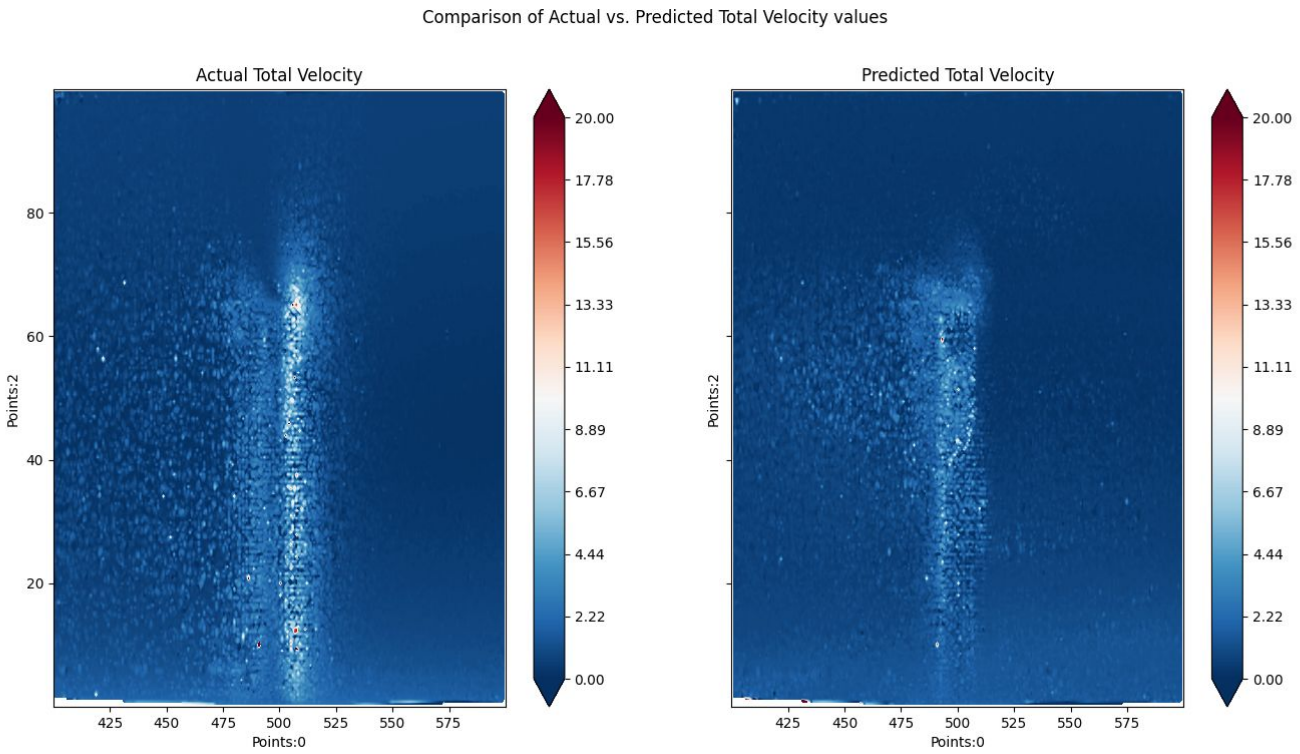
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.9601901	0.9798929	0.5758355	0.03981226655
Velocity:0	0.2669071	0.51663053	0.41429877	0.7330936731
Velocity:1	1.0393374	1.019479	0.5055497	-0.03933458177
Velocity:2	1.7486848	1.3223784	0.5760753	-0.748679781

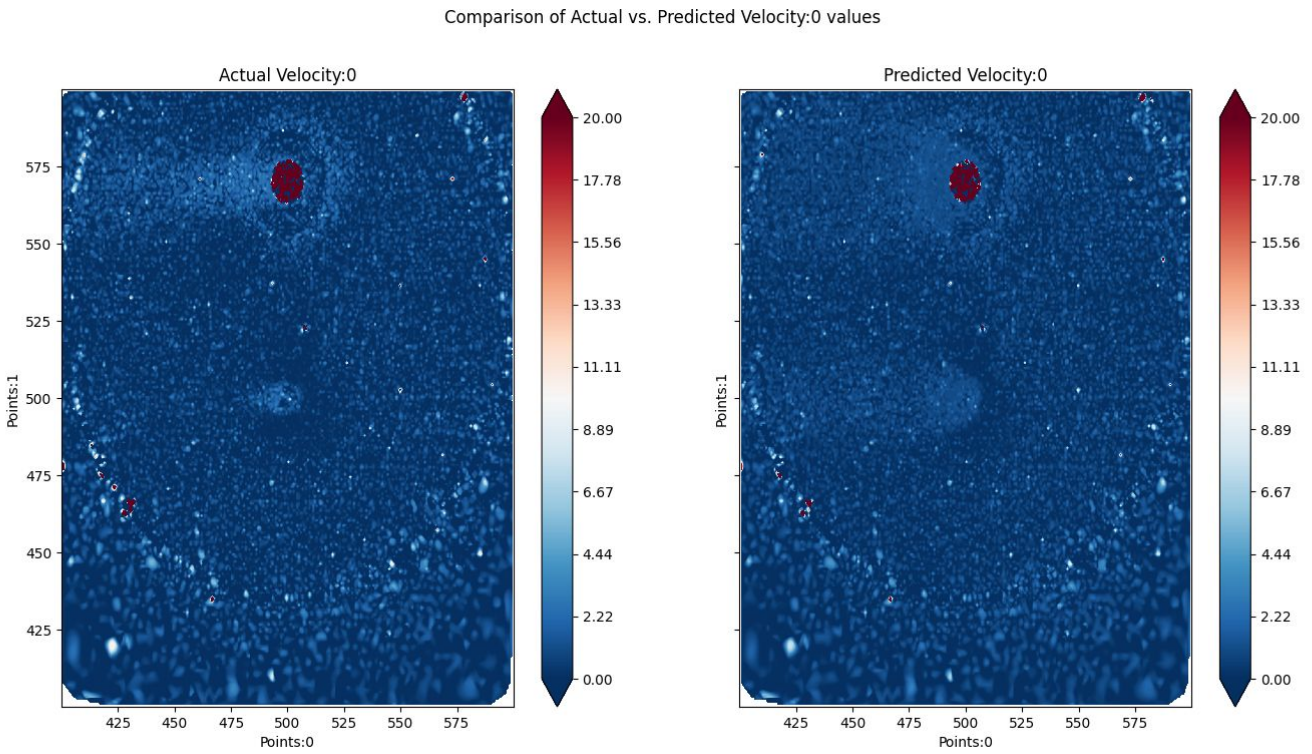
Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Predicting Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Predicting Results - X-Z Total Velocity Plot



Progress so far - Data Loss + Cont Loss (Adam Optimizer) Threshold = 1E-5 (2000 Epochs, so far…), GPU Laptop Predicting Results - X-Z X-Velocity Plot



Progress so far - Data Loss + Cont Loss + RANS loss (Adam Optimizer)

- Running on workstation with GPU

```
2 GPUs available:
GPU 0: NVIDIA GeForce RTX 3090
GPU 1: NVIDIA GeForce RTX 3090
Using device: cuda:1, with 24.348 GB free memory
Skipping Angle - 90 degrees
GPU Total Memory: 24.00 GB
GPU Available Memory: 24.00 GB
GPU with optimal batch size: 211
CPU Total Memory: 255.84 GB
CPU Available Memory: 131.50 GB
CPU with optimal batch size: 1156
Now using device: cuda:0 with optimal batch size: 211
Estimated Memory Requirement for the Batch Size: 23.91 GB
Estimated Memory Requirement for the Full Size: 191502.83 GB
using batches with forced batch size: 16899
Epoch [100/infinity], Loss: 0.1581
Epoch [100/infinity], Loss: 0.1727
Epoch [100/infinity], Loss: 0.1687
Epoch [100/infinity], Loss: 0.1764
Epoch [100/infinity], Loss: 0.1484
Epoch [100/infinity], Loss: 0.1789
Epoch [100/infinity], Loss: 0.1722
Epoch [100/infinity], Loss: 0.1622
Epoch [100/infinity], Loss: 0.1677
Epoch [100/infinity], Loss: 0.1636
Epoch [100/infinity], Loss: 0.1565
Epoch [100/infinity], Loss: 0.1572
Epoch [100/infinity], Loss: 0.1671
Epoch [100/infinity], Loss: 0.1576
Epoch [100/infinity], Loss: 0.1605
Epoch [100/infinity], Loss: 0.1604
Epoch [100/infinity], Loss: 0.1583
Epoch [100/infinity], Loss: 0.1459
Epoch [100/infinity], Loss: 0.1518
Epoch [100/infinity], Loss: 0.1661
Epoch [100/infinity], Loss: 0.1582
```

```
Epoch [3600/infinity], Loss: 0.0069
Epoch [3600/infinity], Loss: 0.0060
Epoch [3600/infinity], Loss: 0.0066
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0064
Epoch [3600/infinity], Loss: 0.0065
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0065
Epoch [3600/infinity], Loss: 0.0073
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0067
Epoch [3600/infinity], Loss: 0.0071
Epoch [3600/infinity], Loss: 0.0072
Epoch [3600/infinity], Loss: 0.0064
Epoch [3600/infinity], Loss: 0.0073
Epoch [3600/infinity], Loss: 0.0067
Epoch [3600/infinity], Loss: 0.0067
Epoch [3600/infinity], Loss: 0.0071
Epoch [3600/infinity], Loss: 0.0065
Epoch [3600/infinity], Loss: 0.0074
Epoch [3600/infinity], Loss: 0.0067
Epoch [3600/infinity], Loss: 0.0072
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0071
Epoch [3600/infinity], Loss: 0.0067
Epoch [3600/infinity], Loss: 0.0075
Epoch [3600/infinity], Loss: 0.0068
Epoch [3600/infinity], Loss: 0.0065
Epoch [3600/infinity], Loss: 0.0070
Epoch [3600/infinity], Loss: 0.0072
Epoch [3600/infinity], Loss: 0.0065
Epoch [3600/infinity], Loss: 0.0073
Epoch [3600/infinity], Loss: 0.0066
Epoch [3600/infinity], Loss: 0.0079
```

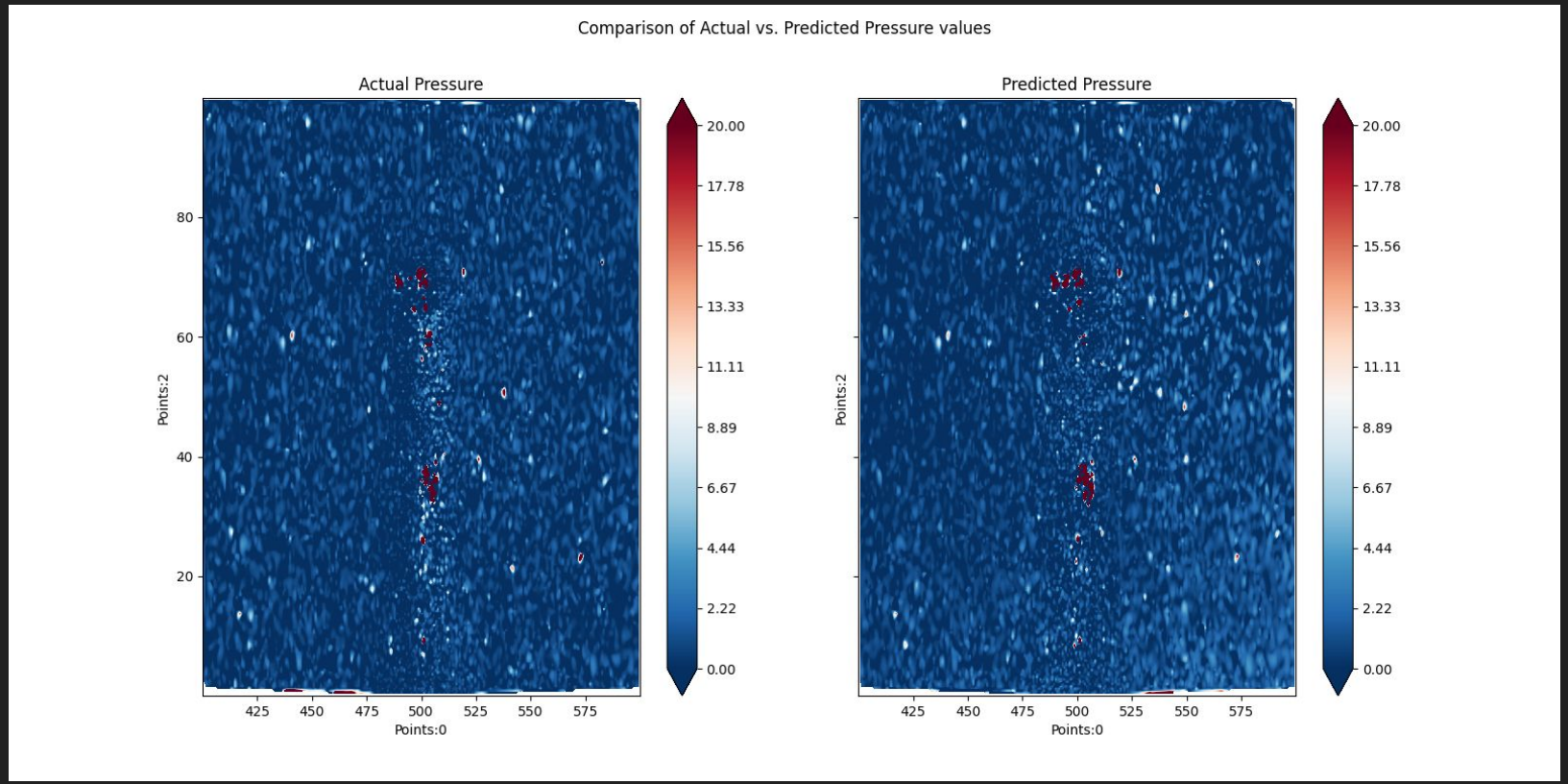
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-3 (87 Epochs), LXPLUS

```
Using device: cpu
Skipping Angle = 90 degrees
CPU Total Memory: 187.43 GB
CPU Available Memory: 42.56 GB
CPU with optimal batch size: 374
Now using device: cpu with optimal batch size: 374
Estimated Memory Requirement for the Batch Size: 42.38 GB
Estimated Memory Requirement for the Full Size: 191502.83 GB
using batches with batch size: 374
Consecutive loss difference less than 0.001 for 10 epochs at epoch 87. Stopping training...
Training completed in 11.10 hours
Overall process completed in 39976.14 seconds
```

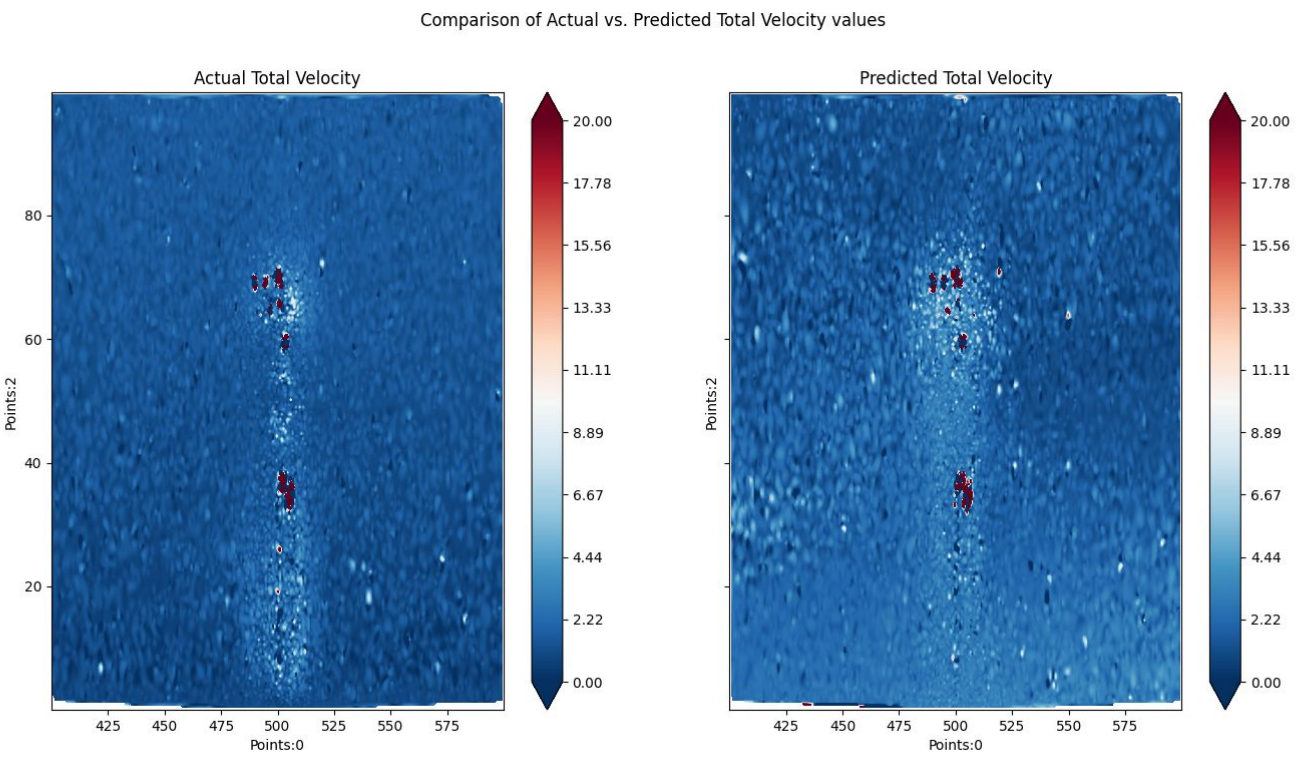
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.87012094	0.93280274	0.5441955	0.130868768
Velocity:0	1.3965502	1.1817572	0.88262904	-0.3945266087
Velocity:1	0.6566806	0.8103583	0.616603	0.3438430316
Velocity:2	2.873269	1.695072	0.8519188	-1.875879224

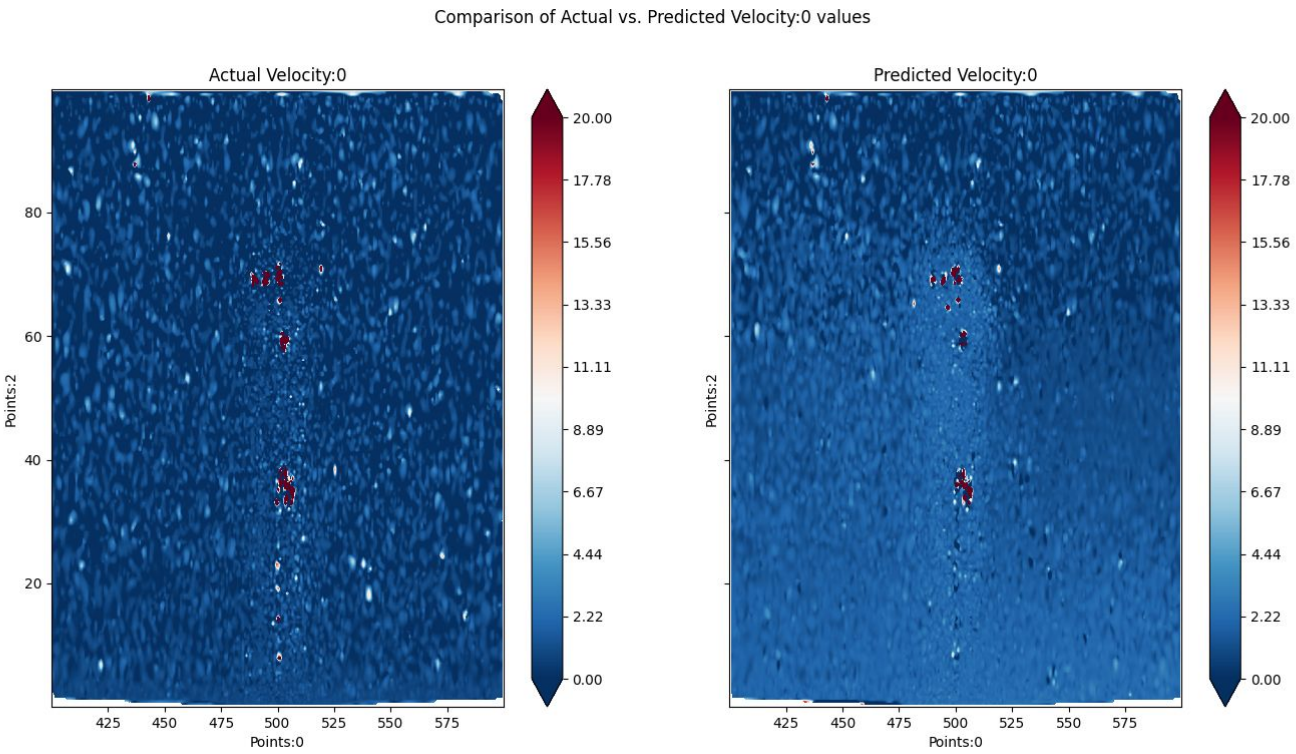
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Testing Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Testing Results - X-Z Total Velocity Plot



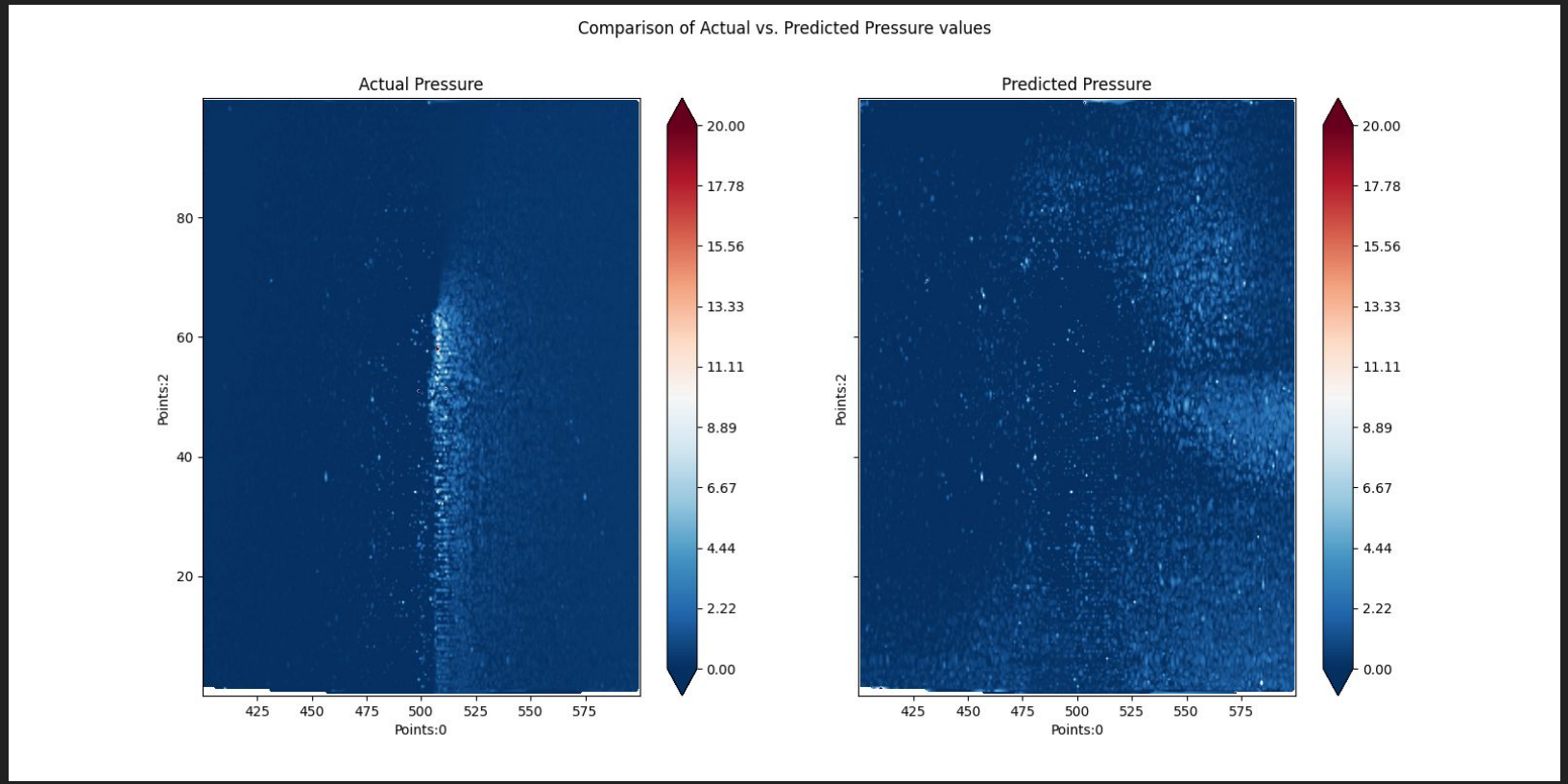
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Testing Results - X-Z X-Velocity Plot



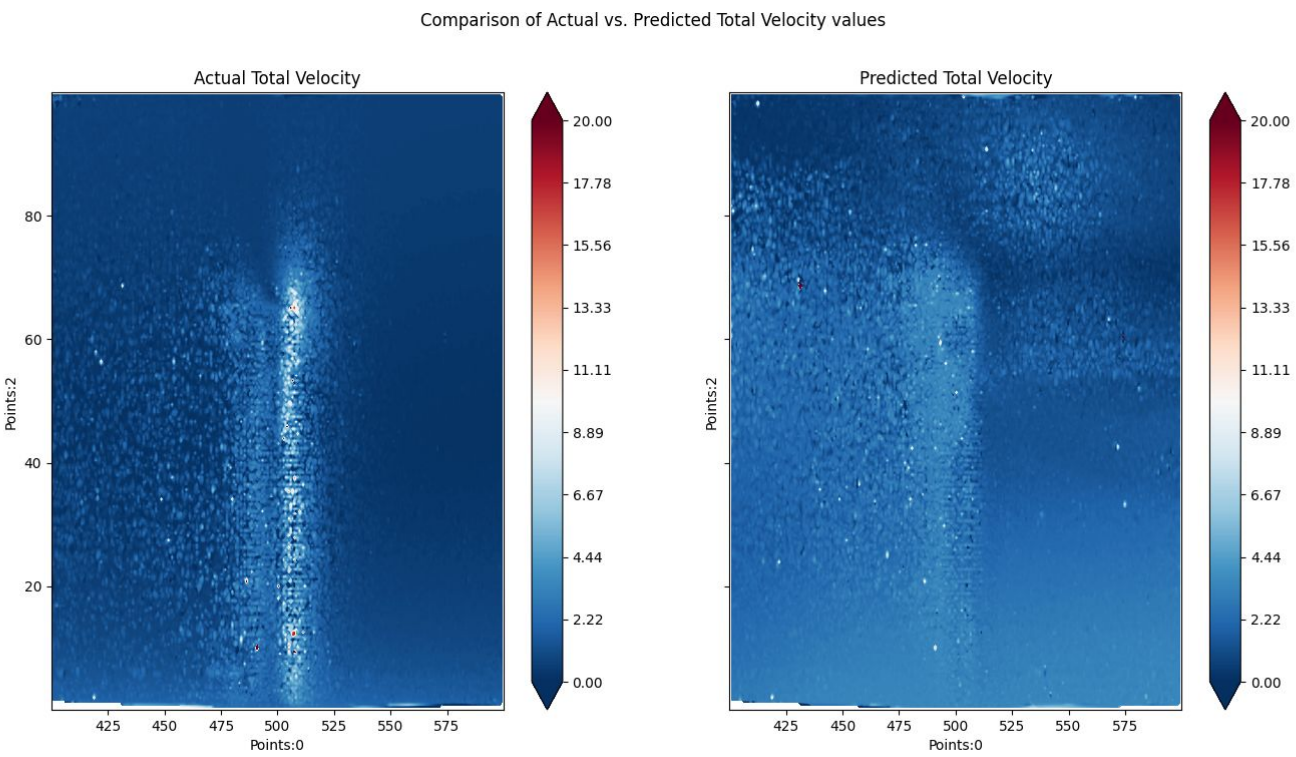
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	1.4854798	1.2188026	0.66694605	-0.4854760706
Velocity:0	1.1143124	1.05561	0.94156647	-0.1143092217
Velocity:1	1.8007631	1.3419251	0.7574644	-0.8007584458
Velocity:2	2.2112052	1.4870121	0.8550787	-1.211198968

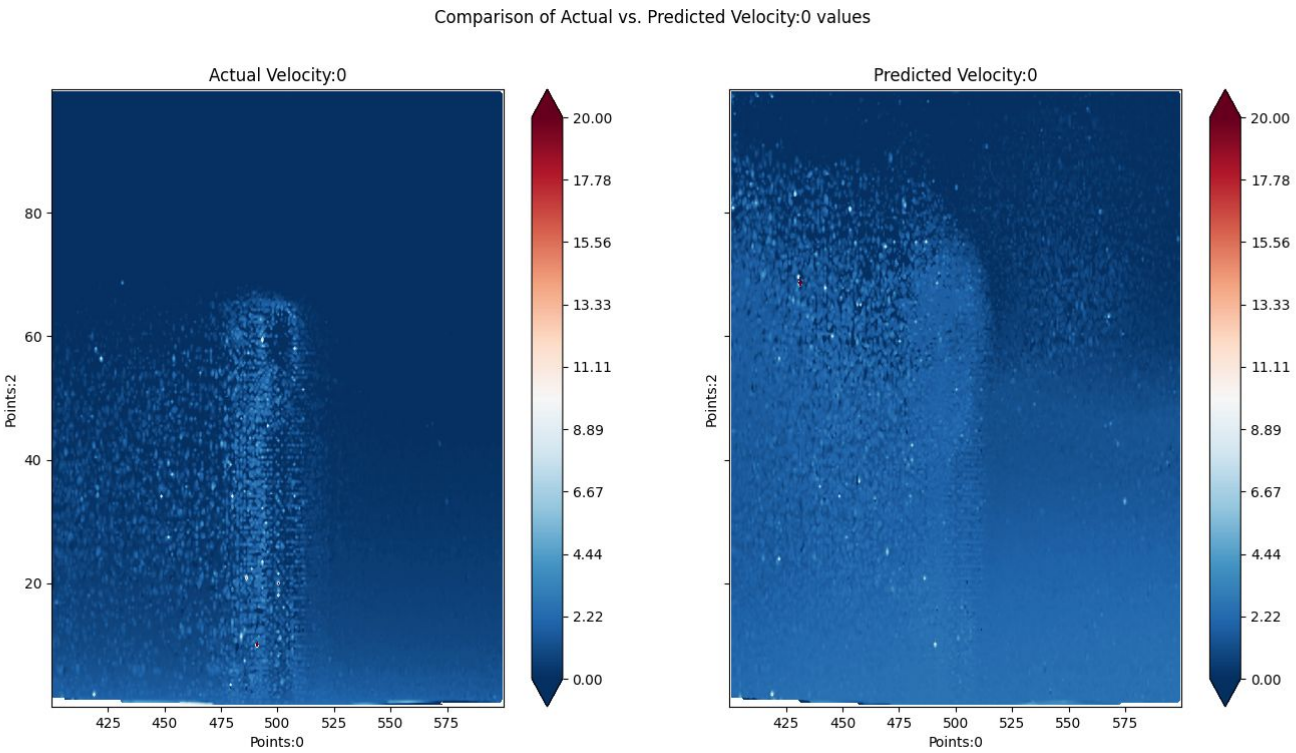
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Predicting Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Predicting Results - X-Z Total Velocity Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-3 (87 Epochs), LXPLUS
Predicting Results - X-Z X-Velocity Plot



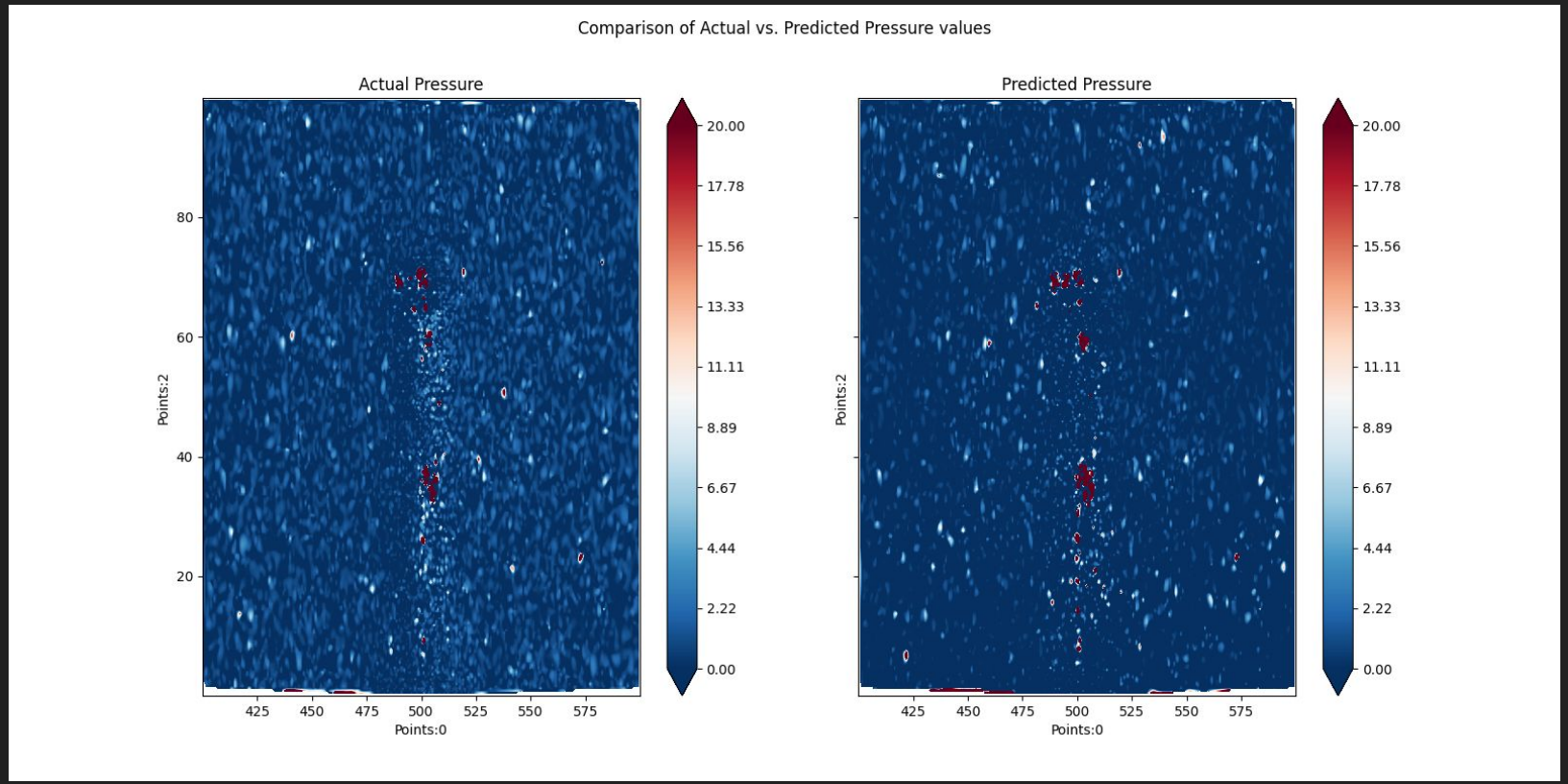
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-4 (780 Epochs), LXPLUS

```
Epoch [700/infinity], Loss: 0.0027, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0021, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0016, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0022, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0025, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0022, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0025, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0020, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0023, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0022, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0039, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0022, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0026, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0040, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0038, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0025, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0033, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0030, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0029, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0023, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0031, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0025, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0030, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0025, Total Time elapsed: 48.09 hours
Epoch [700/infinity], Loss: 0.0035, Total Time elapsed: 48.09 hours
Consecutive loss difference less than 0.0001 for 10 epochs at epoch 780. Stopping training...
Training completed in 59.46 hours
Overall process completed in 214051.48 seconds
```

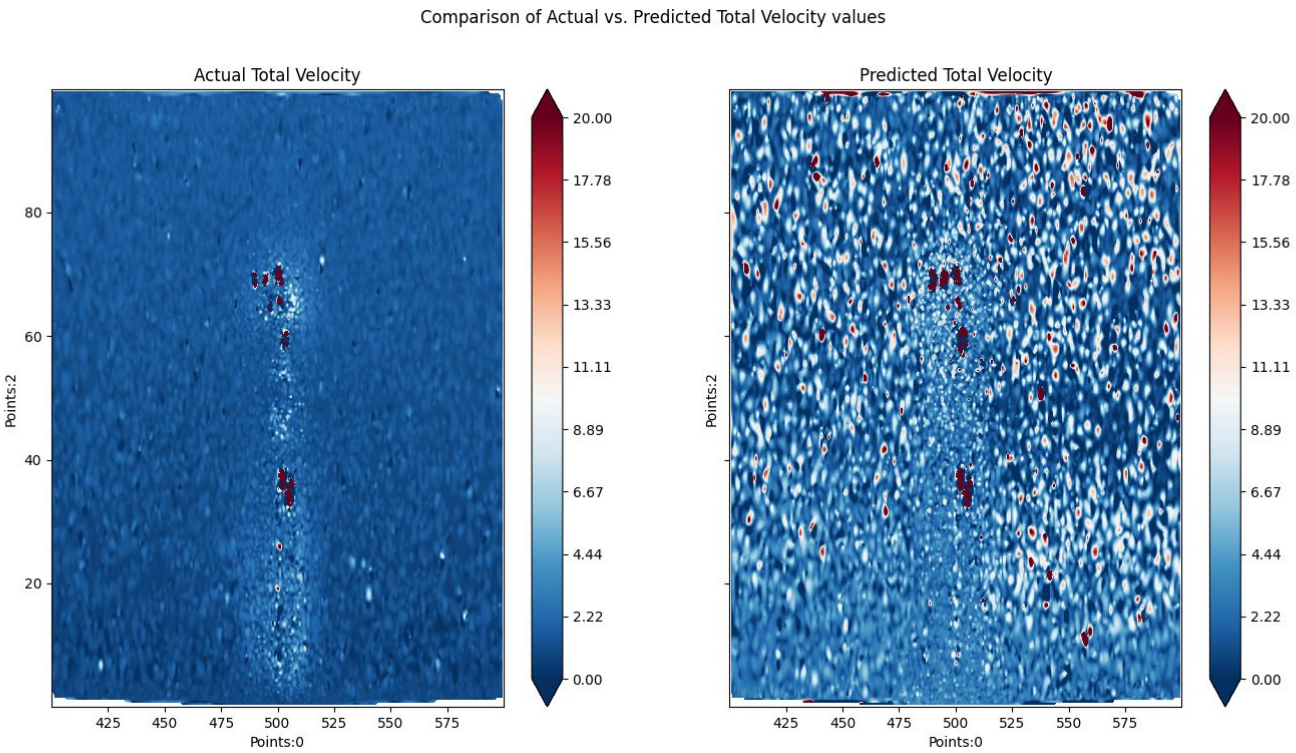
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	3.831787	1.9574951	1.3097245	-2.827428417
Velocity:0	1.2919393	1.1366351	0.8045858	-0.2900675552
Velocity:1	0.6261514	0.79129726	0.6592886	0.3743479256
Velocity:2	7.9996047	2.8283572	1.5170423	-7.006870762

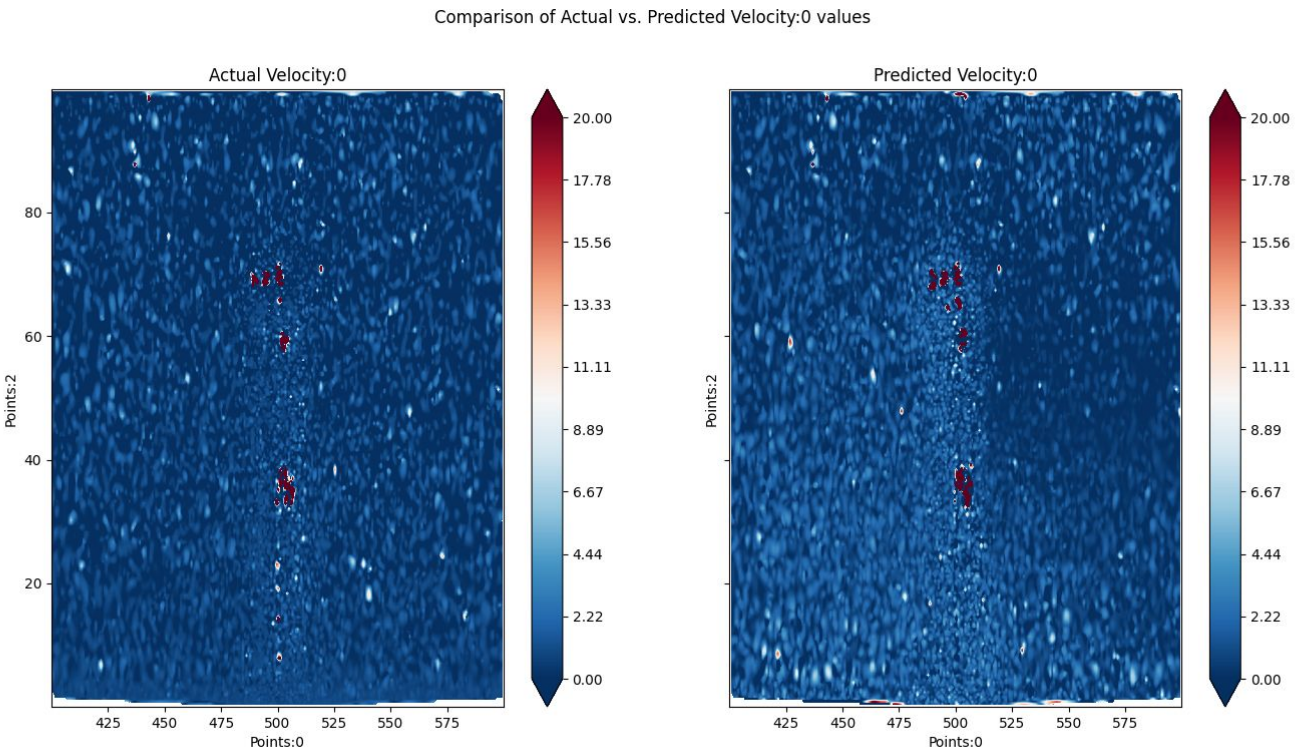
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Testing Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Testing Results - X-Z Total Velocity Plot



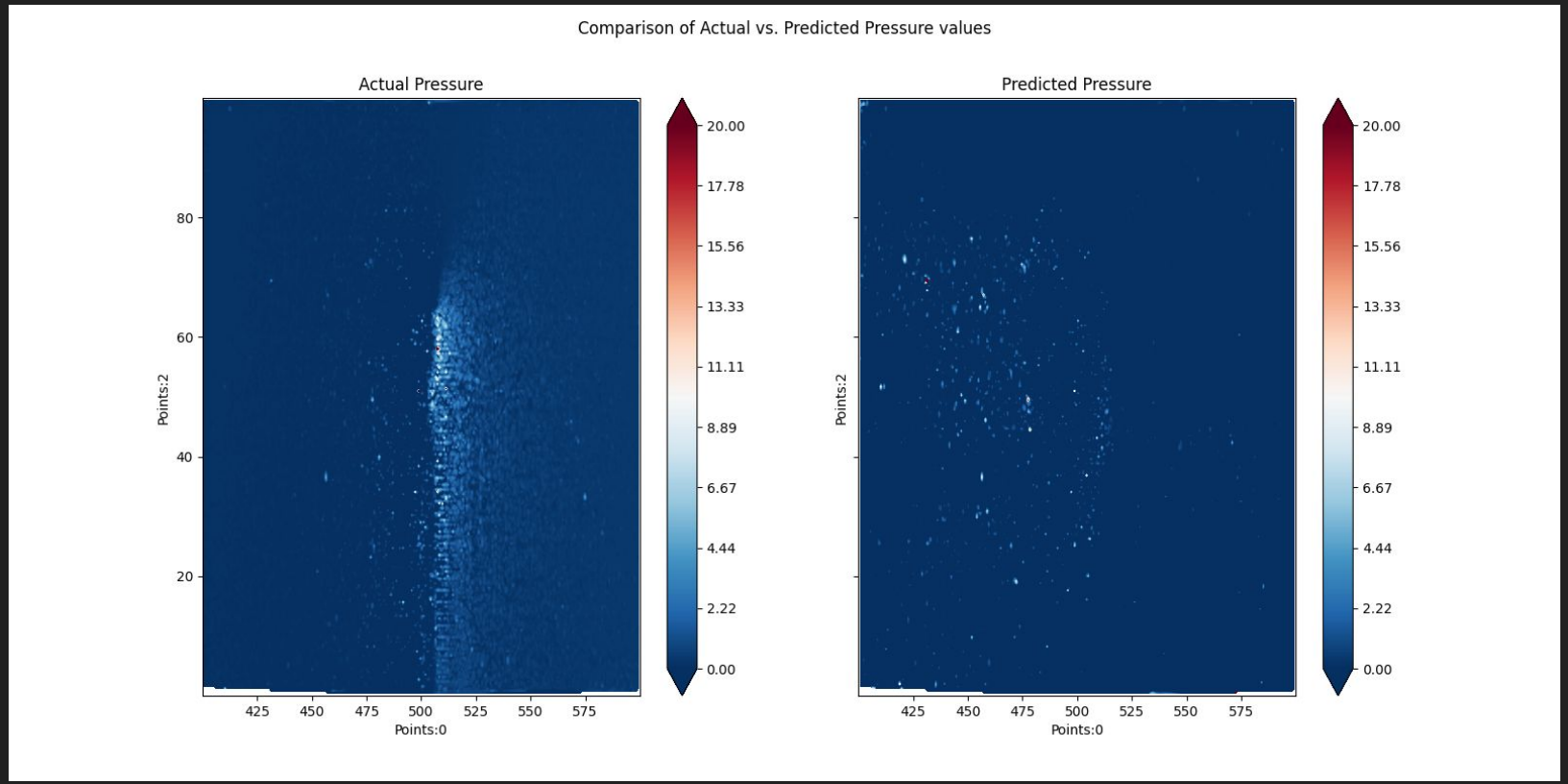
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Testing Results - X-Z X-Velocity Plot



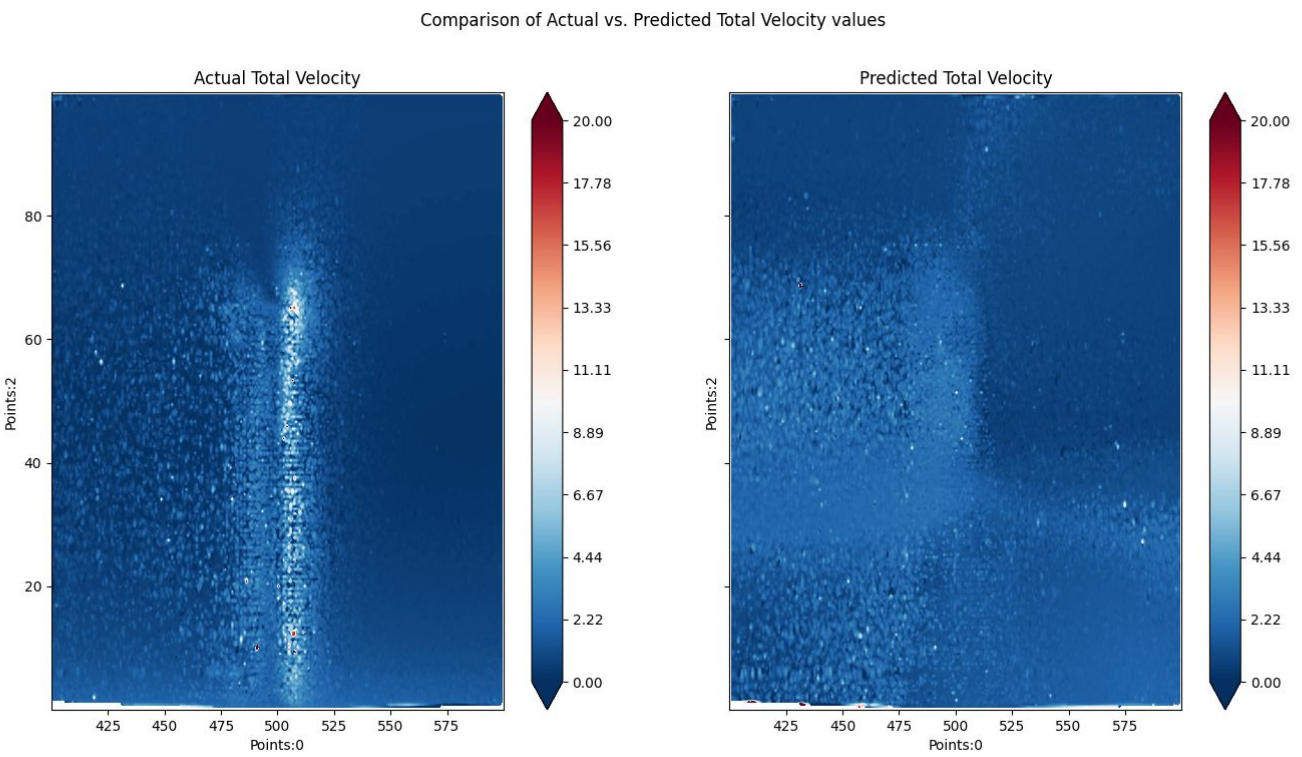
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	3.8450937	1.960891	1.3960195	-2.845083883
Velocity:0	1.197329	1.0942253	0.93782115	-0.1973257392
Velocity:1	1.7244292	1.3131752	0.94741625	-0.7244246907
Velocity:2	1.5756273	1.25524	0.6409877	-0.5756227697

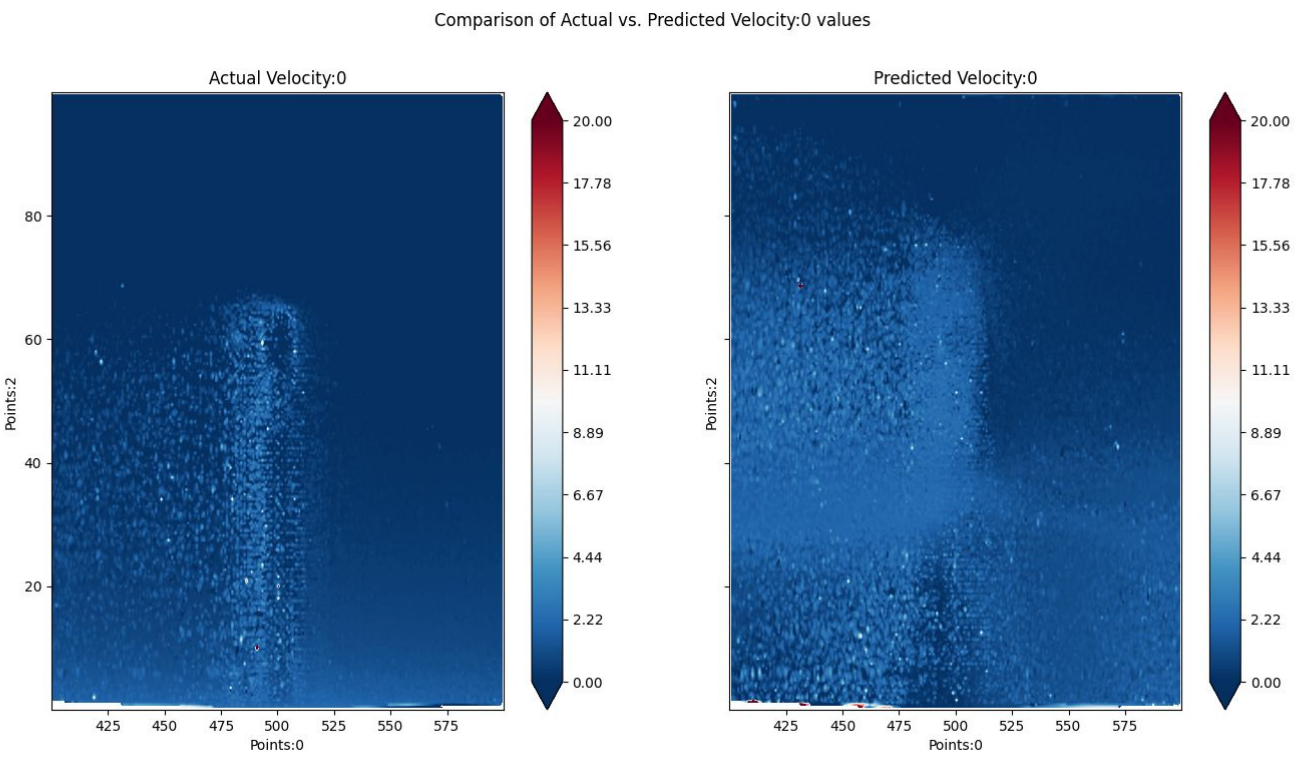
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Predicting Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Predicting Results - X-Z Total Velocity Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer)
Threshold = 1E-4 (780 Epochs), LXPLUS
Predicting Results - X-Z X-Velocity Plot



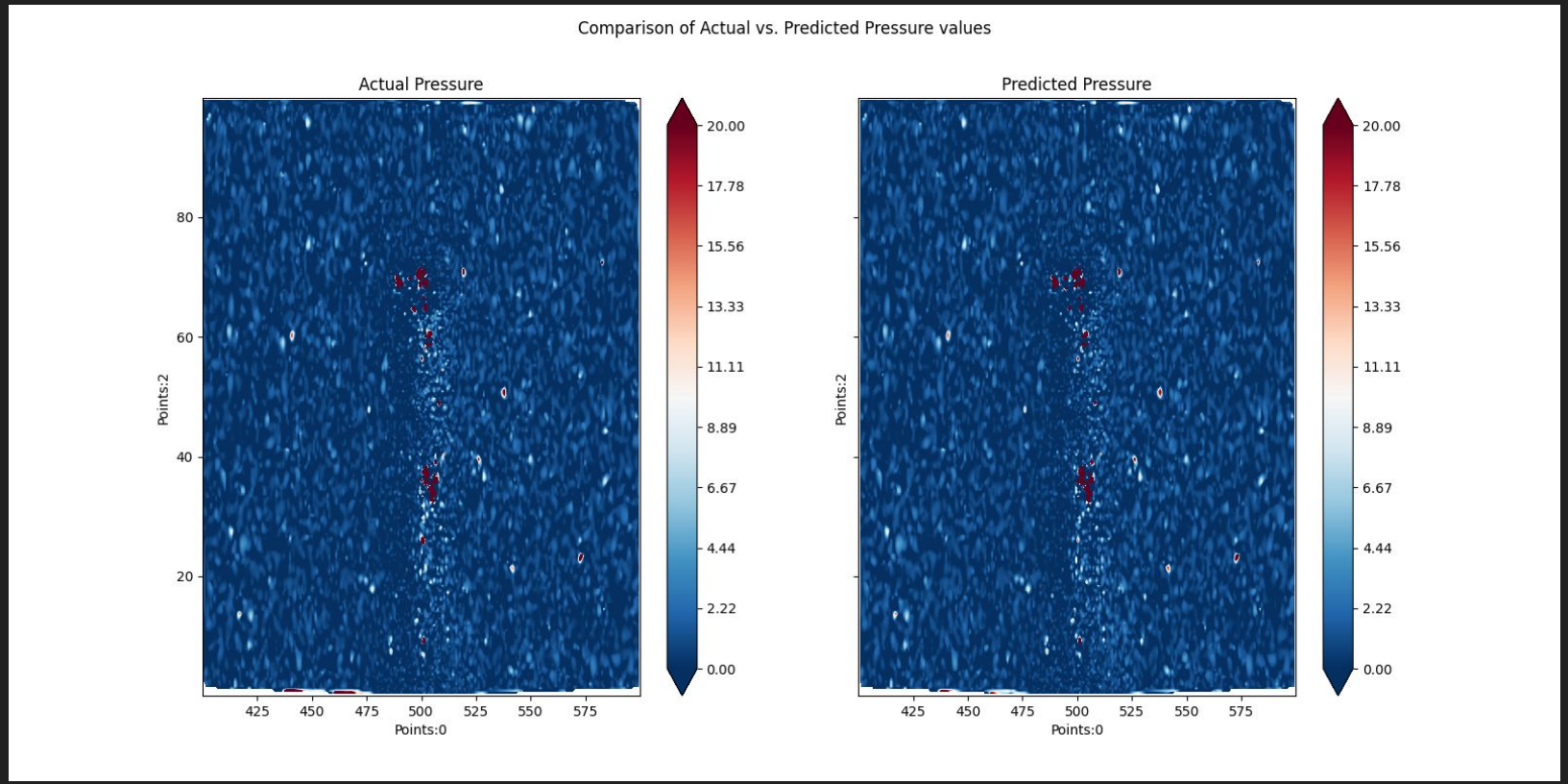
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation

```
Epoch [1400/infinity], Loss: 0.1160, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1178, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1271, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1127, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1254, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1216, Total Time elapsed: 27.72 hours
Epoch [1400/infinity], Loss: 0.1106, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1150, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1149, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1241, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1234, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1196, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1325, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1254, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1119, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1255, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1251, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1324, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1179, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1241, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1128, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1196, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1224, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1136, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1133, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1236, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1222, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1123, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1273, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1167, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1220, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1131, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1139, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1254, Total Time elapsed: 27.73 hours
Epoch [1400/infinity], Loss: 0.1356, Total Time elapsed: 27.73 hours
```

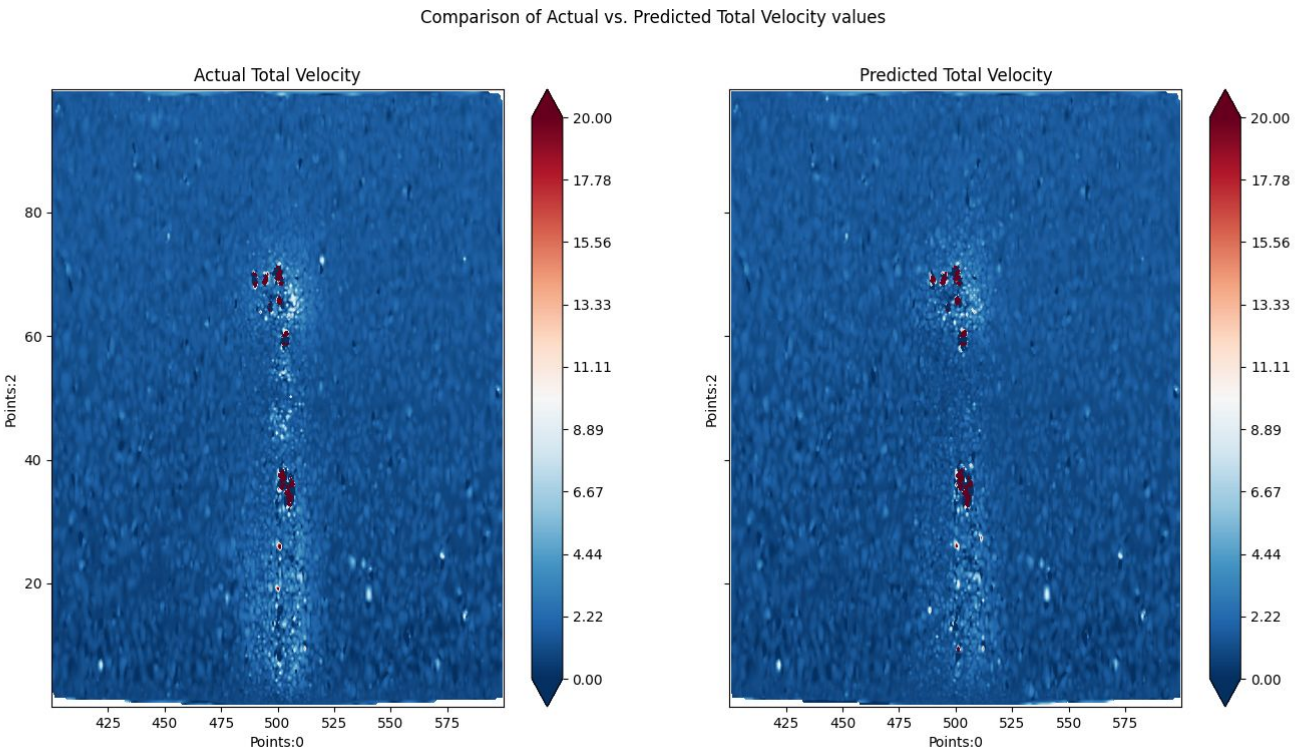
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Testing Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.09319861	0.30528447	0.13558389	0.9069074026
Velocity:0	0.03785014	0.19455113	0.10363934	0.9622046944
Velocity:1	0.016648507	0.1290291	0.074171774	0.9833647719
Velocity:2	0.42117298	0.6489784	0.26142177	0.5784446163

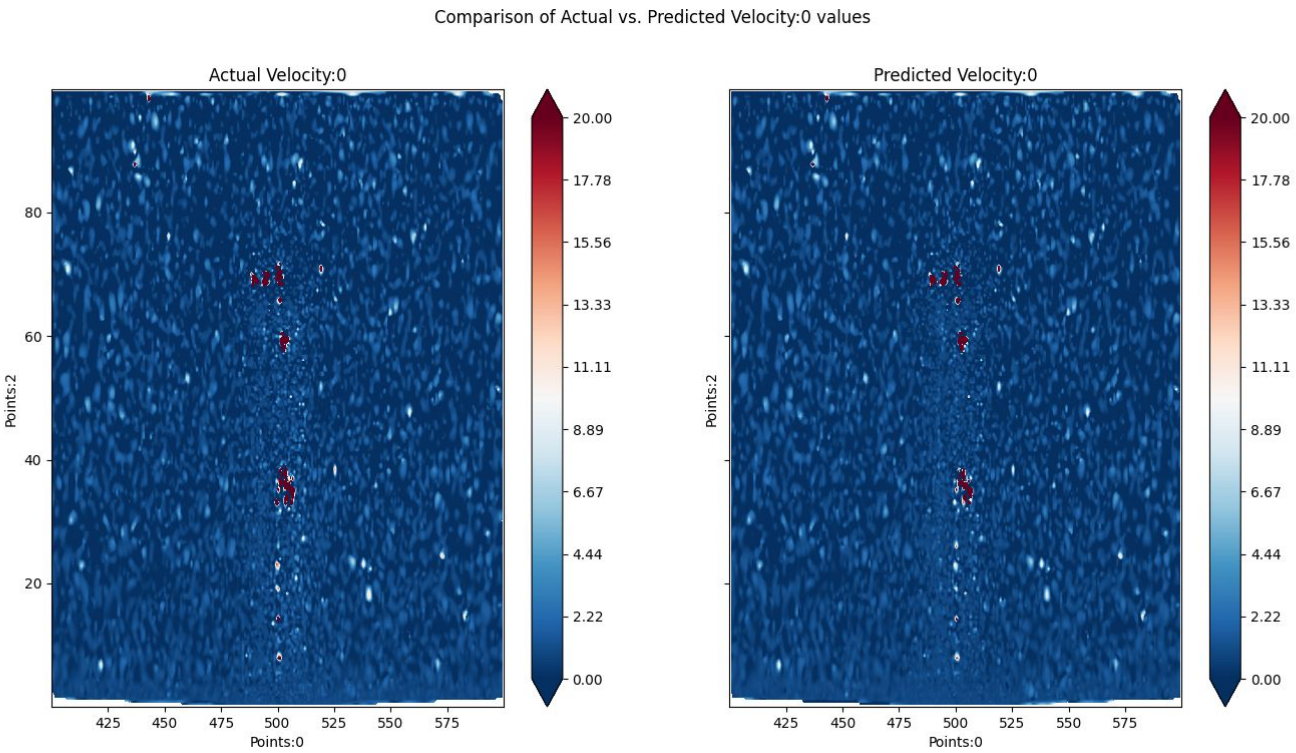
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Testing Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Testing Results - X-Z Total Velocity Plot



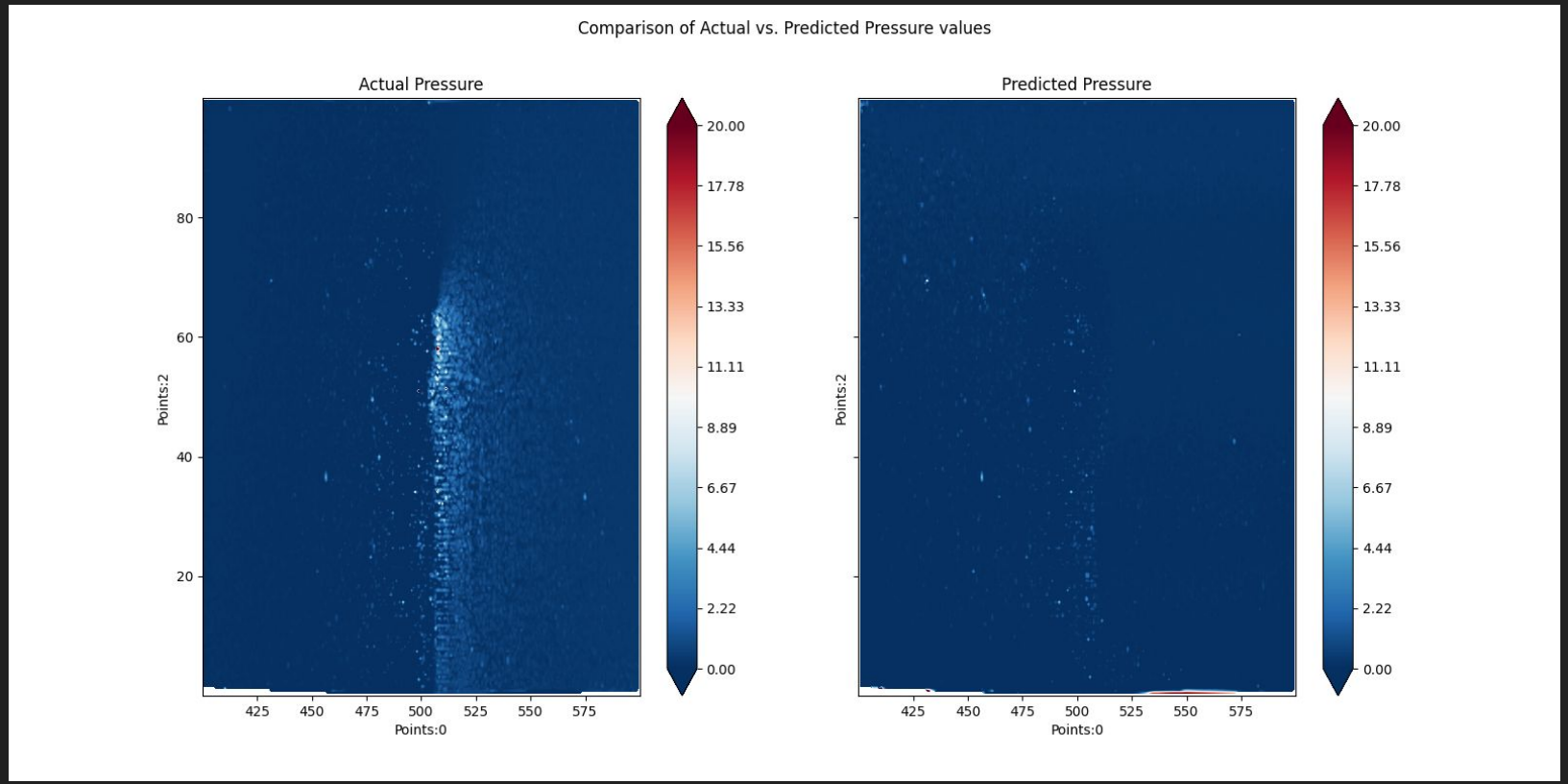
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Testing Results - X-Z X-Velocity Plot



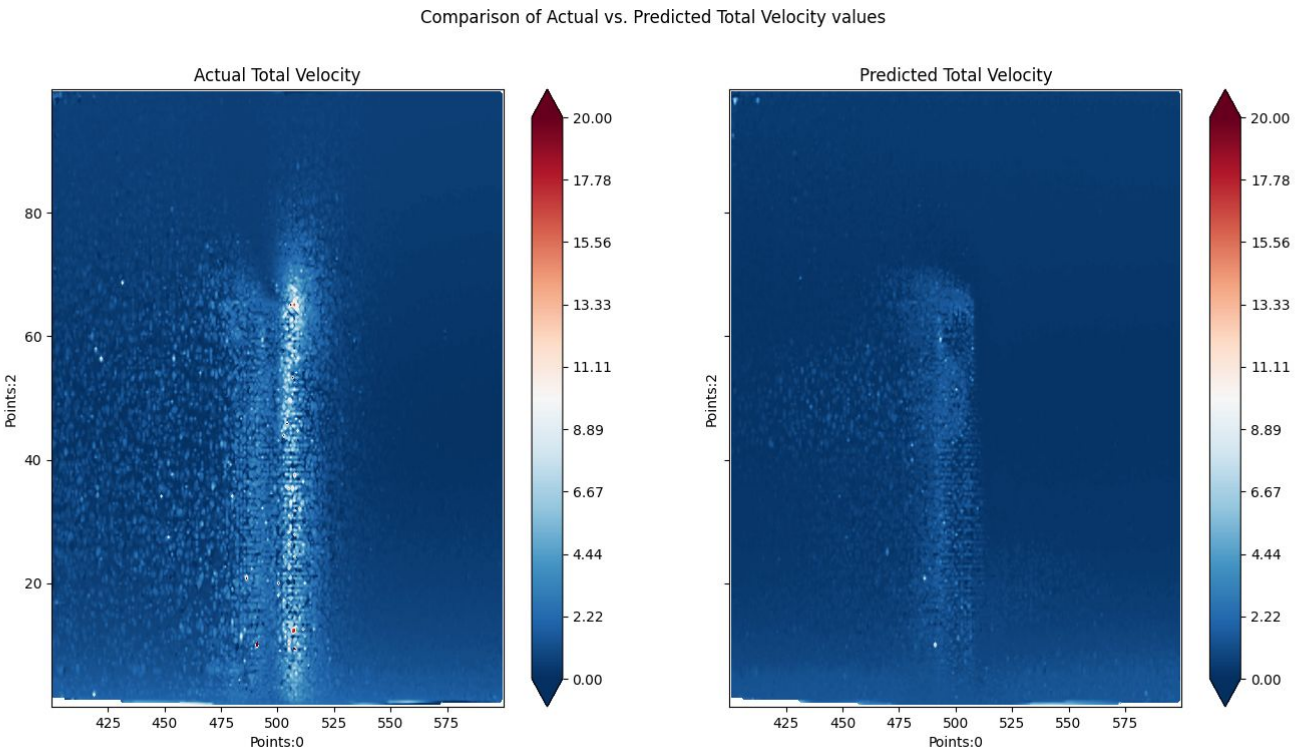
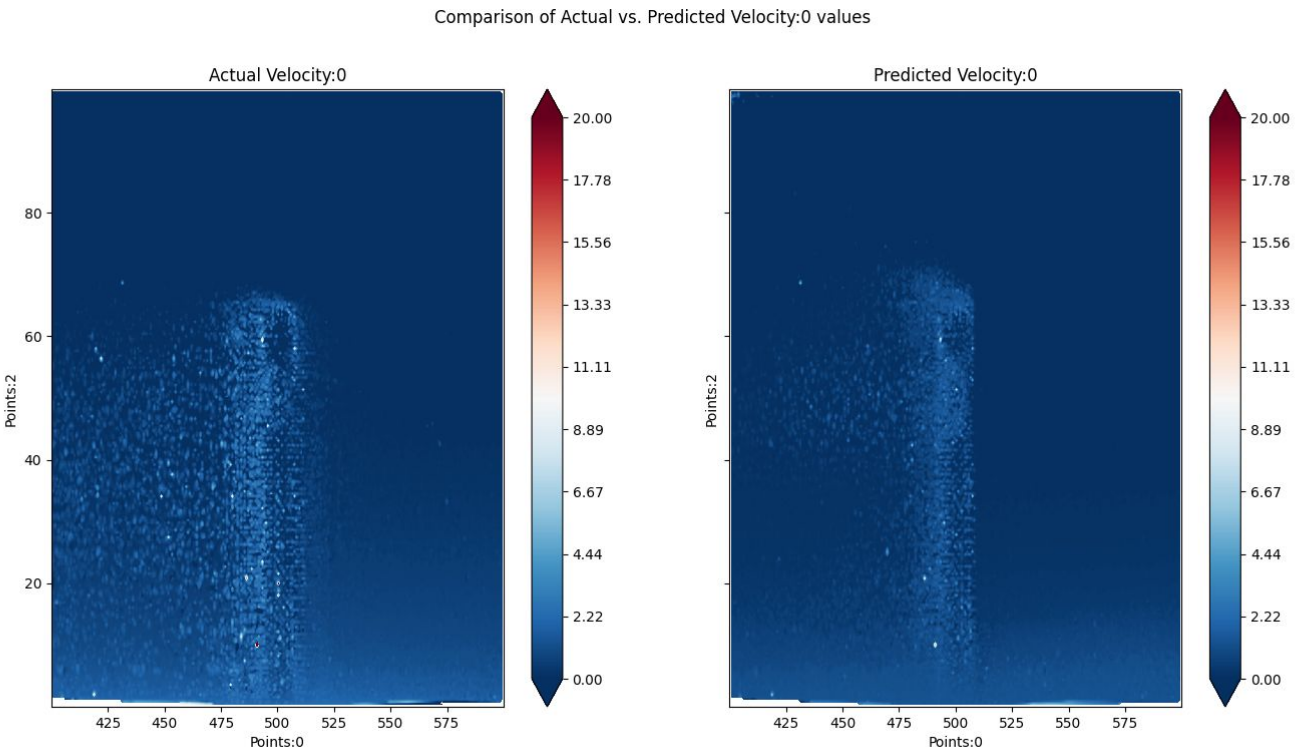
Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Predicting Results - Metrics

Variable	MSE	RMSE	MAE	R2
Pressure	0.7618509	0.8728407	0.40876043	0.2381510579
Velocity:0	0.2119624	0.46039376	0.36220735	0.7880382068
Velocity:1	1.045829	1.0226579	0.47362927	-0.04582620348
Velocity:2	0.9607913	0.98019964	0.41182625	0.03921158678

Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Predicting Results - X-Z Pressure Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Predicting Results - X-Z Total Velocity Plot



Progress so far - Data Loss + Cont Loss + RANS Loss (Adam Optimizer) Threshold = 1E-5 (1400 Epochs so far...), GPU Workstation Predicting Results - X-Z X-Velocity Plot